APPENDIX A

VERSAbus CONNECTOR/PIN DESCRIPTION

A.1 INTRODUCTION

This appendix contains three tables that describe the VERSAbus pin connections. Table A-1 identifies the VERSAbus interface signals by signal mnemonic, connector and pin number, and signal characteristic. Table A-2 identifies connector P1 by pin number and signal mnemonic. Table A-3 identifies connector P2 by pin number and signal mnemonic. Table A-4 provides the dc characteristics of the VERSAbus interface signals.

TABLE A-1. VERSAbus Interface Signal Identification

SIGNAL MNEMONIC	CONNECTOR AND PIN NUMBER	SIGNAL NAME AND DESCRIPTION
ACCLK	P1: 69	AC CLOCK - A totem-pole, input clock signal that indicates the power line frequency and zero transition points.
ACFAIL*	P1: 78	AC FAILURE - An active low, open-collector signal which indicates that the ac input to the power supply is no longer active or that the required input voltage levels are not being met.
APARITY0*	P1: 33	ADDRESS PARITY 0 - Three-state, bidirectional signal which is the odd parity bit for address bits A01*-A23*.
APARITY1*	P2: 88	ADDRESS PARITY 4 - Three-state, bidirectional signal which is the odd parity bit for address bits A24*-A31* for use in 32-bit expansion.
AS*	P1: 30	ADDRESS STROBE - An active low, three-state, output signal that indicates a valid address is on the address bus.
A01*-A23*	P1: 36-58	ADDRESS bus (bits 1-23) - Three-state, output address lines that specify a memory address.
A24*-A31*	P2: 89-96	ADDRESS bus (bits 24-31) - Three-state, output address lines that are reserved for future expansion of the address bus to 32 bits.
BBSY*	P1: 112	BUS BUSY - An active low, open-collector signal generated by the current bus master to indicate that it is using the bus.
BCLR*	P1: 113	BUS CLEAR - An active low, totem-pole signal generated by the bus arbitrator to remove the current bus master in the event a higher level is requesting the bus.

TABLE A-1. VERSAbus Interface Signal Identification (cont'd)

SIGNAL MNEMONIC	CONNECTOR AND PIN NUMBER	SIGNAL NAME AND DESCRIPTION
BERR*	P1: 81	BUS ERROR - An active low, open-collector, input signal generated by a peripheral device. This signal indicates that an unrecoverable error has occurred and the bus cycle must be aborted.
BG0IN*-BG4IN*	P1: 97, 99, 101, 103, 105	BUS GRANT (0-4) IN - Active low, totem-pole, input signals. Bus grant in and out signals form a daisy-chained bus grant. The bus grant in signal indicates to this board that it may become the next bus master.
BG0OUT*-BG4OUT*	P1: 98, 100, 102, 104, 106	BUS GRANT (0-4) OUT - Active low, totem-pole, output signals. Bus grant in and out signals form a daisy-chained bus grant. The bus grant out signal indicates to the next board it may become the next bus master.
BR0*-BR4*	P1: 107-111	BUS REQUEST (0-4) - Active low, open-collector output signals. These signals indicate that a board in the daisy-chain requires access to the bus.
BREL*	P1: 114	BUS RELEASE - An active low, open-collector input signal generated by a peripheral device. This signal serves two purposes. First, it indicates to the current bus master that it must relinquish the bus within 16 bus cycles. Second, it prevents the bus arbitrator from recognizing or acknowledging all bus requests except level zero (BR0*).
DPARITY0*	P1: 21	DATA PARITY 0 - Three-state, bidirectional signal which is the odd parity bit for data bits D00*-D07*.
DPARITY1*	P1: 22	DATA PARITY 1 - Three-state, bidirectional signal which is the odd parity bit for data bits D08*-D15*.
DPARITY2*	P2: 103	DATA PARITY 2 - Three-state, bidirectional signal which is the odd parity bit for data bus D16*-D23* for use in 32-bit expansion.
DPARITY3*	P2: 104	DATA PARITY 3 - Three-state, bidirectional signal which is the odd parity bit for data bits D24*-D31* for use in 32-bit expansion.
DS0*	P1: 25	DATA STROBE 0 - An active low, three-state, output signal that indicates a data transfer will occur on data lines D00*-D07*.
DS1*	P1: 26	DATA STROBE 1 - An active low, three-state, output signal that indicates a data transfer will occur on data lines D08*-D15*.

TABLE A-1. VERSAbus Interface Signal Identification (cont'd)

SIGNAL MNEMONIC	CONNECTOR AND PIN NUMBER	SIGNAL NAME AND DESCRIPTION
DS2*	P2: 99	DATA STROBE 2 - An active low, three-state, output signal that indicates a data transfer will occur on data lines D16*-D23*.
DS3*	P2: 100	DATA STROBE 3 - An active low, three-state, output signal that indicates a data transfer will occur on data lines D24*-D31*.
DTACK*	P1: 29	DATA TRANSFER ACKNOWLEDGE - An active low, open-collector, input signal generated by a peripheral device. This signal indicates that valid data is available on the data bus during a read cycle, or that data has been accepted from the data bus during a write cycle.
D00*-D15*	P1: 5-20	DATA bus (bits 0-15) - Three-state, bidirectional data lines that provide a data path between the bus master and the peripheral device.
D16*-D31*	P2: 105-120	DATA bus (bits 16-31) - Three-state, bidirectional data lines that are reserved for future expansion to 32-bit machines.
EXTDADR*	P1: 60	EXTENDED ADDRESS - An active low, three-state, output signal generated by the bus master. This signal indicates that the memory space beyond the lower 16 megabytes is being addressed.
FC0*-FC3*	P1: 83-86	FUNCTION CODE (0-3) - Three-state, output signals generated by the bus master. These signals indicate the bus master state.
GND	P1:3,4,23, 24,27,28, 31,32,61, 62,67,68, 71,72, 119,120, 123,124, 135-140	GROUND
GND	P2: 1-6, 13,14, 97,98 101,102	GROUND
IACK*	P1: 94	INTERRUPT ACKNOWLEDGE - A three-state signal. This line indicates the bus master is responding to an interrupt request and expects a vector to be placed on the data bus.

TABLE A-1. VERSAbus Interface Signal Identification (cont'd)

SIGNAL MNEMONIC	CONNECTOR AND PIN NUMBER	SIGNAL NAME AND DESCRIPTION
IACKIN*	P1: 95	INTERRUPT ACKNOWLEDGE IN - An active low, totem-pole, input signal. IACKIN* and IACKOUT* signals form a daisy-chained IACK*. The IACKIN* signal indicates to this board that a vector fetch is in progress.
IACKOUT*	P1: 96	INTERRUPT ACKNOWLEDGE OUT - An active low, totem-pole, output signal. IACKIN* and IACKOUT* signals form a daisy-chained IACK*. The IACKOUT* signal indicates to the next board that a vector fetch is in progress.
IOEN*	P1: 59	INPUT OUTPUT ENABLE - An active low, three-state, output signal generated by the bus master. This signal indicates that the address bus contains an I/O address.
[I/O PIN]	P2: 17-66	INPUT/OUTPUT PIN - Signal lines reserved for peripheral signal interface.
IRQ1*-IRQ7*	P1: 87-93	INTERRUPT REQUEST (1-7) - Active low, open-collector, input signals that generate a prioritize interrupt. Level seven is the highest priority.
PDOWN*	P1: 65	POWER DOWN - An active low, open-collector signal which indicates that the dc voltages are out of specification.
RAMDIS*	P1: 66	RANDOM ACCESS MEMORY DISABLE - An active low, open-collector signal that will disable RAM in the system, and allow other devices such as I/O to reside in the middle of a RAM array.
[RESERVED]	P1: 35, 115-118	RESERVED - Signal lines reserved for 32-bit expansion.
	P2: 75-87	
RETRY*	P1: 82	RETRY - An active low, open-collector, input signal generated by a peripheral device. This signal indicates that an error has occurred and the bus cycle must be rerun.
ROMDIS*	P1: 64	READ ONLY MEMORY DISABLE - An active low, open-collector signal that will disable ROM and allow other devices to reside in the middle of a ROM array.
SECIEN*	P1: 77	SECONDARY INTERRUPT ENABLE - An open-collector, output signal. A low level will enable interrupts and bus requests from the secondary map.

TABLE A-1. VERSAbus Interface Signal Identification (cont'd)

SIGNAL MNEMONIC	CONNECTOR AND PIN NUMBER	SIGNAL NAME AND DESCRIPTION
SECMAP*	P1: 63	SECONDARY MAP - An active low, open-collector output signal. This signal selects the secondary memory map when active.
SECRESET*	P1: 73	SECONDARY RESET - An open-collector, input signal. A low level on this line will cause user or secondary hardware to be reset.
[SERCOM1 - [SERCOM4]	P2: 71-74	SERIAL COMMUNICATION (1-4) - Signal lines reserved for serial communications.
SYSCLK	P1: 70	SYSTEM CLOCK - A constant 16 MHz clock signal that is independent of processor speed. This signal is generated by the host processor and used for general timing.
SYSFAIL*	P1: 80	SYSTEM FAIL - An active low, open-collector input signal that indicates a board has failed the test program.
SYSPACK	P1: 76	SYSTEM PAUSE ACKNOWLEDGE - An active high, open-collector bus signal which indicates that all intelligent devices have achieved a recoverable wait state in response to the activation of SYSPAUSE*.
SYSPAUSE*	P1: 75	SYSTEM PAUSE - An active low, open-collector bus signal which signals the intelligent devices in the system to halt their present tasks, and enter a wait state until this signal is deactivated. Acknowledgment of this wait state is done through SYSPACK.
SYSRESET*	P1: 74	SYSTEM RESET - An active low, open-collector, input signal which, when active, will cause the system to be reset.
TEST*	P1: 79	TEST - An active low, open-collector signal which initiates the self test mode for all intelligent system boards.
WRITE*	P1: 34	WRITE - Three-state, output signal that defines the cycle type as read or write. A high level indicates a read operation, and a low level indicates a write operation.
+5V STDBY	P1: 133-134	+5 Vdc STANDBY - This line supplies +5 Vdc to devices requiring battery backup.
+5V	P1: 1,2, 129-132 P2: 7-10	+5 Vdc Power - Used by the system logic circuits.

TABLE A-2. Connector P1 Identification

ODD PIN NUMBER (COMPONENT SIDE)	SIGNAL MNEMONIC	EVEN PIN NUMBER (CIRCUIT SIDE)	SIGNAL MNEMONIC
1	+5V	2	+5V
3	GND	4	GND
5	D00*	6	D01*
7	D02*	8	D03*
9	D04*	10	D05*
11	D06*	12	D07*
13	D08*	14	D09*
15	D10*	16	D11*
17	D12*	18	D13*
19	D14*	20	D15*
21	DPARITY0*	22	DPARITY1*
23	GND	24	GND
25	DS0*	26	DS1*
27	GND	28	GND
29	DTACK*	30	AS*
31	GND	32	GND
33	APARITY0*	34	WRITE*
35	[RESERVED]	36	A01*
37	A02*	38	A03*
39	A04*	40	A05*
41	A06*	42	A07*
43	A08*	44	A09*
45	A10*	46	A11*
47	A12*	48	A13*
49	A14*	50	A15*
51	A16*	52	A17*
53	A18*	54	A19*
55	A20*	56	A21*
57	A22*	58	A23*
59 AM4*	IOEN*	60 AM7*	EXTDADR*
61	GND	62	GND
63 AM3*	SECMAP*	64	ROMDIS*
65	PDOWN*	66	RAMDIS*
67	GND	68	GND
69	ACCLK	70	SYSCLK ✓ 16M
71	GND	72	GND
73	SECRESET*	74	SYSRESET*
75	SYSPAUSE*	76	SYSPACK
77	SECIEN*	78	ACFAIL*
79	TEST*	80	SYSFAIL*
81 AMØ*	BERR*	82	RETRY*
AM0— 83 AM2*	FC0*	84 AM1*	FC1*
AM2— 85	FC2*	86 AM6*	FC3*
87	IRQ1*	88	IRQ2*
89	IRQ3*	90	IRQ4*
91	IRQ5*	92	IRQ6*
93	IRQ7*	94 AM5*	IACK*
95	IACKIN*	96	IACKOUT*
97	BG0IN*	98	BG0OUT*
99	BG1IN*	100	BG1OUT*

TABLE A-2. Connector P1 Identification (cont'd)

ODD PIN NUMBER (COMPONENT SIDE)	SIGNAL MNEMONIC	EVEN PIN NUMBER (CIRCUIT SIDE)	SIGNAL MNEMONIC
101	BG2IN*	102	BG2OUT*
103	BG3IN*	104	BG3OUT*
105	BG4IN*	106	BG4OUT*
107	BR0*	108	BR1*
109	BR2*	110	BR3*
111	BR4*	112	BBSY*
113	BCLR*	114	BREL*
115	[RESERVED]	116	[RESERVED]
117	[RESERVED]	118	[RESERVED]
119	GND	120	GND
121	-12V	122	-12V
123	GND	124	GND
125	+12V	126	+12V
127	+12V	128	+12V
129	+5V	130	+5V
131	+5V	132	+5V
133	+5V STDBY	134	+5V STDBY
135	GND	136	GND
137	GND	138	GND
139	GND	140	GND

PC

TABLE A-1. VERSAbus Interface Signal Identification (cont'd)

SIGNAL MNEMONIC	CONNECTOR AND PIN NUMBER	SIGNAL NAME AND DESCRIPTION
+12V	P1: 125-128	+12 Vdc Power - Used by the system logic circuits.
	P2: 11, 12	
+15V	P2: 69, 70	+15 Vdc Power - Used by the system logic circuits.
-12V	P1: 121, 122	-12 Vdc Power - Used by the system logic circuits.
	P2: 15, 16	
-15V	P2: 67, 68	-15 Vdc Power - Used by the system logic circuits.

NOTES:
1. All input/output bus signal references are with respect to the bus master.
2. The bus master is the device on the VERSAbus that is in control of the transaction at the present time.

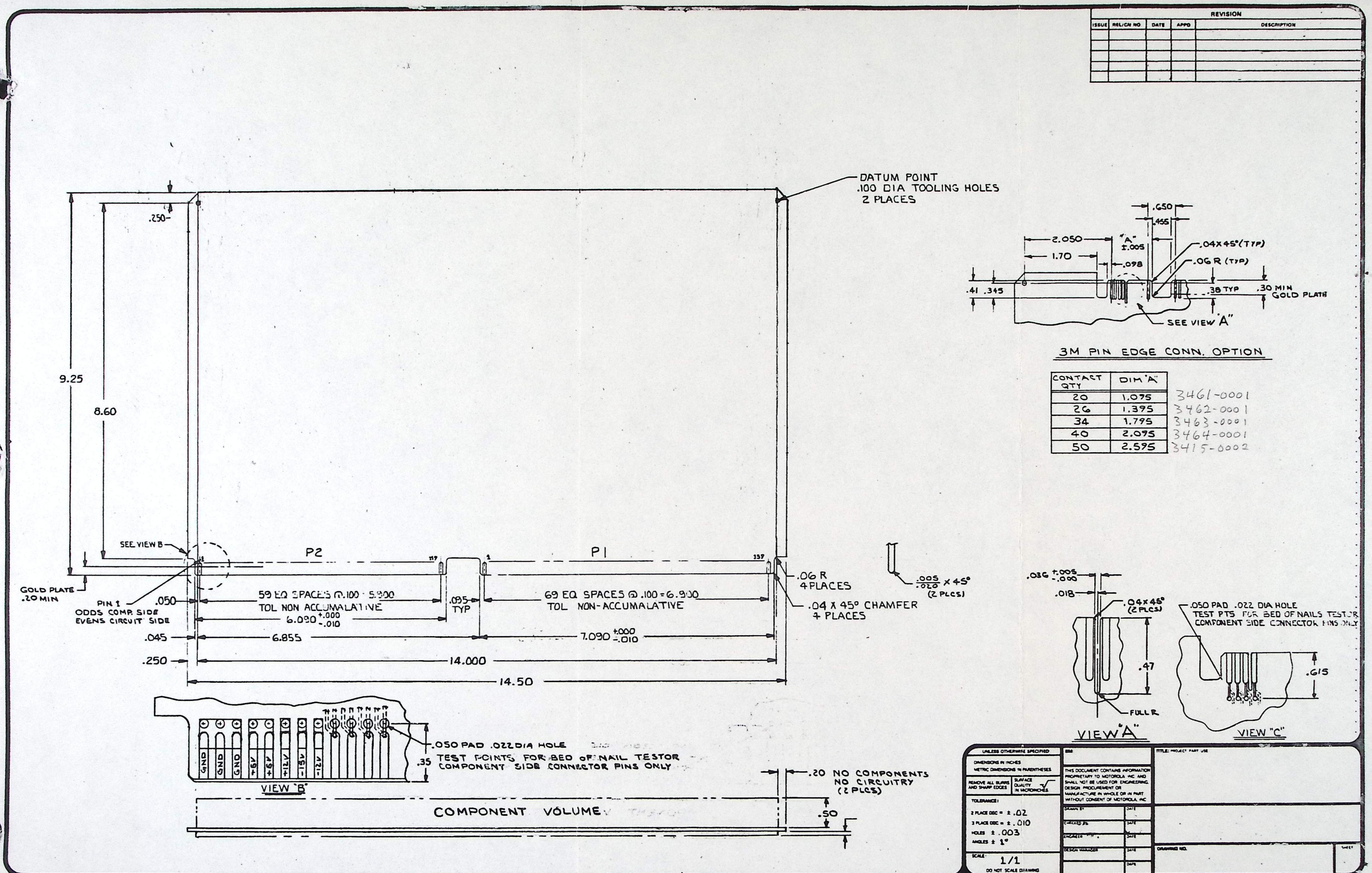


FIGURE B-1. Standard Printed Circuit Board Specifications

BOARD	SPACE	BASE ADDRESS
FLOPPY CONTROLLER	512 BYTES	FF0000
TIMING & BLANKING	512 BYTES	FF1000
RASTER GENERATOR	1K BYTES	FF1400
ROTATION MATRIX	1K BYTES	FF1800
CRT DRIVER	1K BYTES	FF1C00
VIDEO BOARD	1K BYTES	FF2000
OSCILLATOR 1	1K BYTES	FF2400
OSCILLATOR 2	1K BYTES	FF2800
OSCILLATOR 3	1K BYTES	FF2C00
COLORIZER 1	1K BYTES	FF3000
COLORIZER 2	1K BYTES	FF3400
COLORIZER 3	1K BYTES	FF3800
COLORIZER 4	1K BYTES	FF3C00
COLORIZER 5	1K BYTES	FF4000
COLORIZER 6	1K BYTES	FF4400
COLORIZER 7	1K BYTES	FF4800
COLORIZER 8	1K BYTES	FF4C00
COMMUNICATION I/O	64 BYTES	FFC000
CONSOLE INTERFACE	64 BYTES	FFC100
GRAPHICS 1	2K BYTES	E00000
GRAPHICS 2	2K BYTES	E01000
GRAPHICS 3	2K BYTES	E02000
GRAPHICS 4	2K BYTES	E03000
VECTOR GENERATOR	2K BYTES	E08000
COMMUNICATIONS MEMORY	16K BYTES	E10000

USER 2000 BDADDR.DOC

BOARD	SPACE	BASE ADDRESS
FLOPPY CONTROLLER	512 BYTES	FF0000
TIMING & BLANKING	512 BYTES	FF1000
RASTER GENERATOR	1K BYTES	FF1400
ROTATION MATRIX	1K BYTES	FF1800
CRT DRIVER	1K BYTES	FF1C00
VIDEO BOARD	1K BYTES	FF2000
OSCILLATOR 1	1K BYTES	FF2400
OSCILLATOR 2	1K BYTES	FF2800
OSCILLATOR 3	1K BYTES	FF2C00
COLORIZER 1	1K BYTES	FF3000
COLORIZER 2	1K BYTES	FF3400
COLORIZER 3	1K BYTES	FF3800
COLORIZER 4	1K BYTES	FF3C00
COLORIZER 5	1K BYTES	FF4000
COLORIZER 6	1K BYTES	FF4400
COLORIZER 7	1K BYTES	FF4800
COLORIZER 8	1K BYTES	FF4C00
COMMUNICATION I/O	64 BYTES	FFC000
CONSOLE INTERFACE	64 BYTES	FFC100
GRAPHICS 1	2K BYTES	E00000
GRAPHICS 2	2K BYTES	E01000
GRAPHICS 3	2K BYTES	E02000
GRAPHICS 4	2K BYTES	E03000
VECTOR GENERATOR	2K BYTES	E08000
COMMUNICATIONS MEMORY	16K BYTES	E10000

VERSEFX ROUTING SWITCHER —— SOURCES AND DESTINATIONS

X-CHANGES

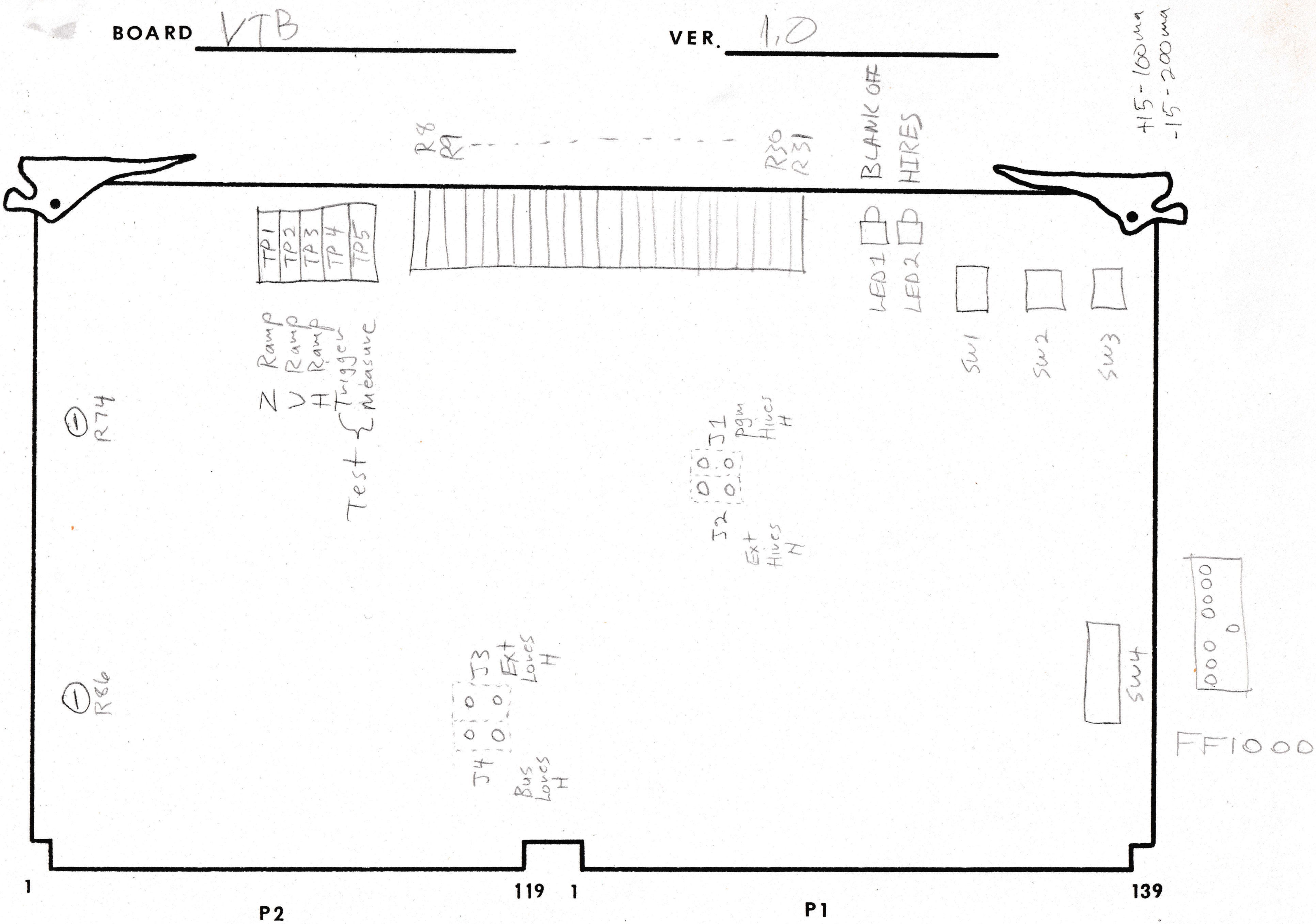
	#	SOURCE		#	DESTINATION
	0	NOIR		0	LIAISION ANALOGIQUES
	1	VOLET		1	LIAISION ANALOGIQUES
	2	DEMITEINTES		2	LIAISION ANALOGIQUES
	3	GRILLE		3	LIAISION ANALOGIQUES
	4	VERT 1		4	ENT. CANAL 1
	5	VERT 2		5	ENT. CANAL 2
	6	VERT 3		6	ENT. CANAL 3
	7	R DEC. PAL		7	ENT. R COL. 1
	8	V DEC. PAL		8	ENT. V COL. 1
	9	B DEC. PAL		9	ENT. B COL. 1
	10	R CAMERA		10	ENT. R COL. 2
	11	V CAMERA		11	ENT. B COL. 2
	12	B CAMERA		12	ENT. V COL. 2
	13	R AUX		13	ENT. R COL. 3
	14	V AUX		14	ENT. V COL. 3
	15	B AUX		15	ENT. B COL. 3
	16	R FLYING SPOT		16	ENT. R COL. 4
	17	V FLYING SPOT		17	ENT. V COL. 4
	18	B FLYING SPOT		18	ENT. B COL. 4
	19	CANAL 1		19	VID. VERS COLORIEUR 1
	20	CANAL 2		20	VID. VERS COLORIEUR 2
	21	CANAL 3		21	VID. VERS COLORIEUR 3
X	22	TRANSC. SECAM / PAL		22	VID. VERS COLORIEUR 4
	23	R VERSEFX		23	ENT. R COD. PAL
	24	V VERSEFX		24	ENT. V COD. PAL
	25	B VERSEFX		25	ENT. B COD. PAL
	26	MAG. 1	X	26	ENT. R MEM.
	27	MAG. 2	X	27	ENT. V MEM.
	28	MAG. 3	X	28	ENT. B MEM.
X	29	R MEM.		29	ENT. GRILLE G2
X	30	V MEM.	X	30	ENT. R MON. CONT.
X	31	B MEM.	X	31	ENT. V MON. CONT.
X	32	EXT 1	X	32	ENT. B MON. CONT.
	33	PGM MEL.	X	33	ENT. DEC. PAL
	34	PVW MEL.	X	34	TRANSC. PAL / SECAM
	35	M/E1 MEL.		35	MEL. ENT. LIB. 1
	36	M/E2 MEL.		36	MEL. ENT. LIB. 2
X	37	SYNTHETISEUR		37	MEL. ENT. LIB. 3
	38	BARRES	X	38	CONT. CAM. VERT
	39	CODEUR VERSEFX		39	ENT. MEL. VERSEFX

VERSEFX ROUTING SWITCHER --- SOURCES & DESTINATIONS

#	SOURCE	REMARKS	#	DESTINATION	INITIAL SOURCE
1	BLACK		1	ANALOG BUS	
2	SWR WIPE		2	ANALOG BUS	
3	GRAY SCALE		3	ANALOG BUS	
4	GRID		4	ANALOG BUS	
5	ART CAM 1*		5	RESCAN 1 IN	ART CAM 1
6	ART CAM 2*		6	RESCAN 2 IN	ART CAM 2
7	ART CAM 3*		7	RESCAN 3 IN	ART CAM 3
8	DECODER R (PAL)		8	COLORIZER 1 R IN	DECODER R
9	DECODER G (PAL)		9	COLORIZER 1 G IN	DECODER G
10	DECODER B (PAL)		10	COLORIZER 1 B IN	DECODER B
11	CAMERA R		11	COLORIZER 2 R IN	CAMERA R
12	CAMERA G		12	COLORIZER 2 G IN	CAMERA G
13	CAMERA B		13	COLORIZER 2 B IN	CAMERA B
14	DECODER R (SECAM)		14	COLORIZER 3 R IN	AUX R
15	DECODER G (SECAM)		15	COLORIZER 3 G IN	AUX G
16	DECODER B (SECAM)		16	COLORIZER 3 B IN	AUX B
17	FLYING SPOT R		17	COLORIZER 4 R IN	FLYING SPOT R
18	FLYING SPOT G		18	COLORIZER 4 G IN	FLYING SPOT G
19	FLYING SPOT B		19	COLORIZER 4 B IN	FLYING SPOT B
20	RESCAN CAM 1=		20	COLORIZER 1 VID IN	RESCAN CAM 1
21	RESCAN CAM 2=		21	COLORIZER 2 VID IN	RESCAN CAM 2
22	RESCAN CAM 3=		22	COLORIZER 3 VID IN	RESCAN CAM 3
23	SPARE		23	COLORIZER 4 VID IN	BLACK
24	COLORIZERS R=		24	ENCODER R IN	COLORIZERS R
25	COLORIZERS G=		25	ENCODER G IN	COLORIZERS G
26	COLORIZERS B=		26	ENCODER B IN	COLORIZERS B
27	VTR 1		27	RGB PGM MON R IN	COLORIZERS R
28	VTR 2		28	RGB PGM MON G IN	COLORIZERS G
29	VTR 3		29	RGB PGM MON B IN	COLORIZERS B
30	VTR 4		30	UTILITY MON 1 IN	
31	VTR 5		31	UTILITY MON 2 IN	
32	VTR 6	COMPOSITE	32	UTILITY MON 3 IN	
33	CAMERA	COLOR SIGNALS	33	DECODER IN (PAL)	BARS
34	SWITCHER PGM		34	DECODER IN (SECAM)	BARS
35	SWITCHER PVW		35		
36	SWITCHER M/E 1		36	SWITCHER SPARE 1 IN	
37	SWITCHER M/E 2		37	SWITCHER SPARE 2 IN	
38	SWITCHER M/E 3		38	SWITCHER SPARE 3 IN	
39	BARS		39	WAVEFORM & VECTORSCOPE IN	BARS
40	VERSEFX ENCODER=		40	SWITCHER VERSEFX IN	VERSEFX ENCODE

= NOT NORMALLY CHANGED
* HI-RES SOURCE

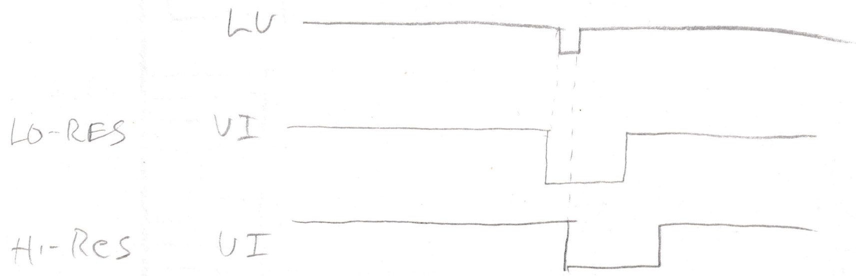
BOARD VTB VER. 1.0

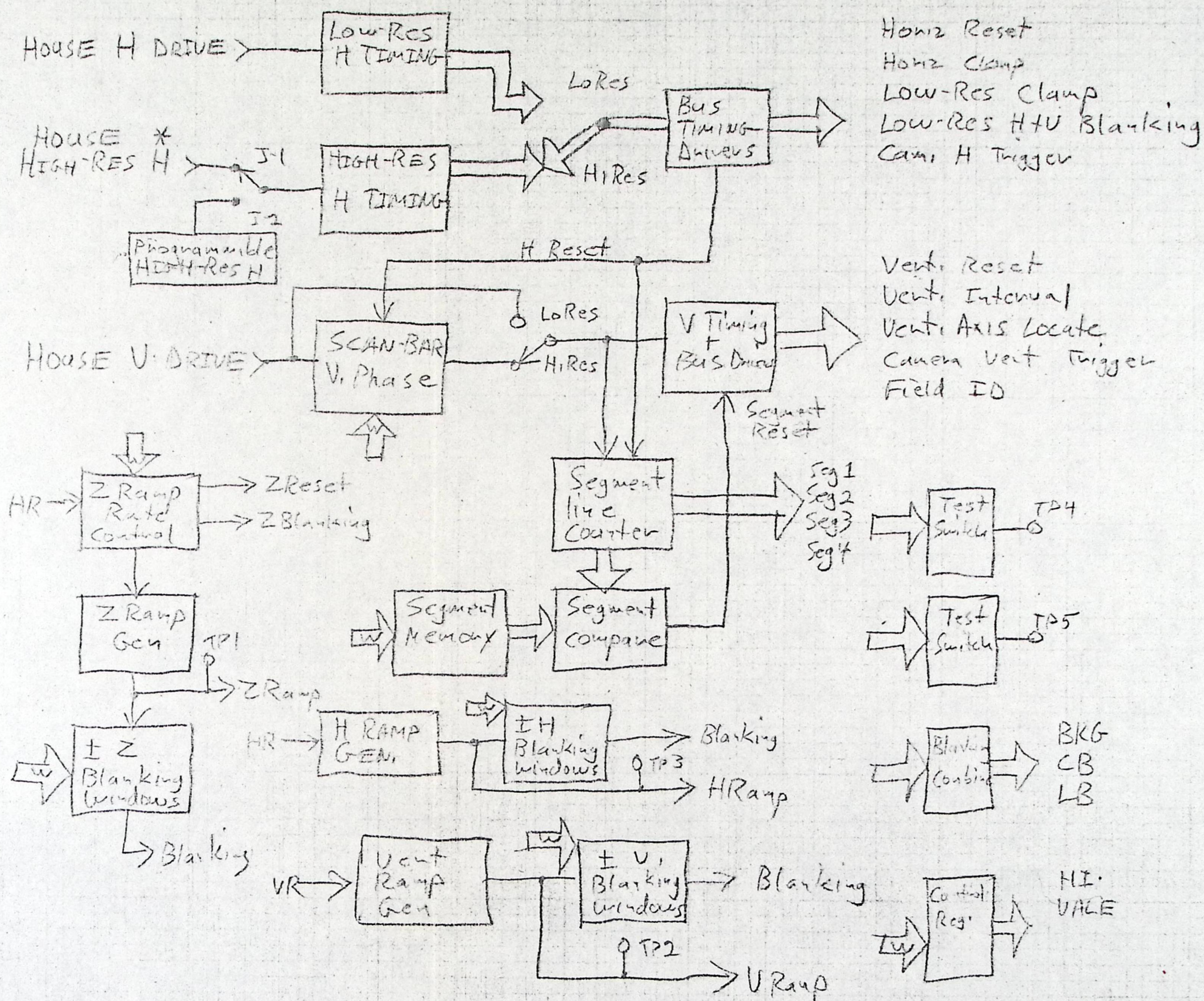


VTB current consumption

+15V 106 ma
-15V 226 ma

0-511 Hi NTSC



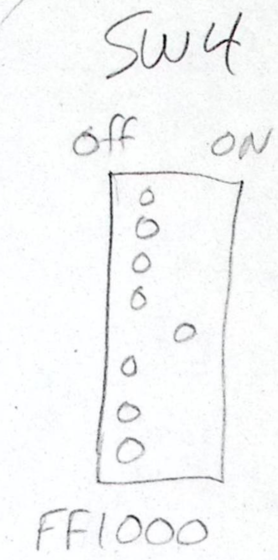

HOUSE H DRIVE
Low-Res H TIMING
LoRes
Bus TIMING Drivers
Horiz Reset
Horiz Clamp
Low-Res Clamp
Low-Res H+V Blanking
Cam. H Trigger
HOUSE HIGH-RES H *
J-1
J-2
HIGH-RES H TIMING
HiRes
Programmable HIGH-RES H
H Reset
Vert. Reset
Vert. Interval
Vert. Axis Locate
Camera Vert Trigger
Field ID
HOUSE V. DRIVE
SCAN-BAR V. Phase
LoRes
HiRes
V Timing + Bus Driver
Segment Reset
Z Ramp Rate Control
HR
Z Reset
Z Blanking
Segment line Counter
Seg 1
Seg 2
Seg 3
Seg 4
Test Switch
TP4
Z Ramp Gen
TP1
Segment Memory
Segment Compare
Test Switch
TP5
Z Ramp
± Z Blanking Windows
HR
H RAMP GEN.
±H Blanking Windows
Blanking
TP3
H Ramp
Blanking Combine
BKG
CB
LB
Blanking
VR
Vert Ramp Gen
± V. Blanking Windows
Blanking
TP2
V Ramp
Control Reg.
HI-
VACE

DTACK = 125 N SEC

RESCAN CHANNEL: THE BLANKING PARAMETERS CAN EFFECT AS MANY AS SIXTEEN RASTER SEGMENTS OF VARIABLE LENGTH AT A TIME.

FLYING SPOT CHANNEL: THE BLANKING PARAMETERS EFFECT THE ENTIRE RASTER. NO SEGMENTING IS AVAILABLE.

[redacted]



BLANKING FIXED TO RASTER	OFFSET		
+ X EDGE	0 - 4095	VERTICAL +32 - 47	FF1040 → FF105E
- X EDGE	0 - 4095	48 - 63	FF1060 → FF107E
+ Y EDGE	0 - 4095	HORIZONTAL 64 - 79	FF1080 → FF109E
- Y EDGE	0 - 4095	80 - 95	FF10A0 → FF10BE
+ Z EDGE	0 - 4095	Z 96 - 111	FF10C0 → FF10DE
- Z EDGE	0 - 4095	112 - 127	FF10E0 → FF10FE

@000 (Bottom)
@FFF (TOP)
000 FFF R L
000 FFF

16 segment change registers & contain ~~last video line~~ # of lines.

THE TIMING CARD PROVIDES TIMING SIGNALS FOR THE ENTIRE SYSTEM. THERE ARE FIFTEEN SEGMENT CHANGE REGISTERS WHICH CONTAIN THE NUMBER OF ~~THE LAST LINE OF ALL OF THE~~ SEGMENTS ~~EXCEPT SEGMENT SIXTEEN WHICH BY CONVENTION IS THE LAST LINE OF THE VIDEO.~~ THERE IS ONE SCAN BAR ADJUST REGISTER, ONE TEST & TRIGGER REGISTER AND ONE CONTROL REGISTER.

		OFFSET		
	SEGMENT CHANGE	0 - 1023	BASE+16 → BASE+31	FF1020 → FF103E
01	SCAN BAR ADJUST	0 - 1023	BASE+2 FF1004	
FFF	Z RAMP RATE	0 - 4095	BASE+3 FF1006 init FFF	

TEST & TRIGGER REGISTER BASE+1 FF1002

BITS		
0 - 4	TEST LINE SELECT	0 - 31
5 - 7	TRIGGER SELECT	0 - 7

CONTROL REGISTER BASE+Ø FF1000

	BITS			
1=HI	0	HIGH RESOLUTION	ON/OFF	GREEN LED
1=Yes	1	SECTION VERTICAL RESET	ENABLE/DISABLE	
1=VAL	2	VERTICAL AXIS LOCATE	ENABLE/DISABLE	
1=Blank	3	BLANK OFF CRT	ENABLE/DISABLE	RED LED
1=ON	4	Z RESET ENABLE	ENABLE/DISABLE	
1=off	5	STANDARD BLANKING	ENABLE/DISABLE	
1=off	6	RASTER RELATIVE BLANKING	ENABLE/DISABLE	
1=off	7	SCREEN RELATIVE BLANKING	ENABLE/DISABLE	

CRs	
Seg	(16)
+X	(16)
-X	(16)
+Y	(16)
-Y	(16)
+Z	(16)
-Z	(16)

NTSC L	NTSC H	PAL L	PAL H	
107	1E9	138	24B	Hex
263	489	312	587	Dec

J1 - program Hires H
✓ J2 - External Hires H
✓ J3 - External Lores H
J4 - Bus (P2-92) H

VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17		18	LO-RES SYNC IN (EIA)
19	VERT, RAMP OUT @	20	HI-RES HOR. IN (EIA)
21		22	LO-RES HOR. IN (EIA)
23	HOR. RAMP OUT @	24	LO-RES VERT. IN (EIA)
25		26	ART CAM VERT TRIG. OUT
27	Z RAMP OUT @	28	ART CAM HOR. TRIG. OUT
29		30	ART CAM BLANKING OUT
31		32	
33		34	
35		36	
37		38	
39		40	
41		42	
43		44	
45		46	
47		48	
49		50	
51		52	
53		54	
55		56	
57		58	
59		60	
61		62	
63		64	
65		66	
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane. ALL other pins are.

@ = ANALOG SIGNAL

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

ANALOG BUS

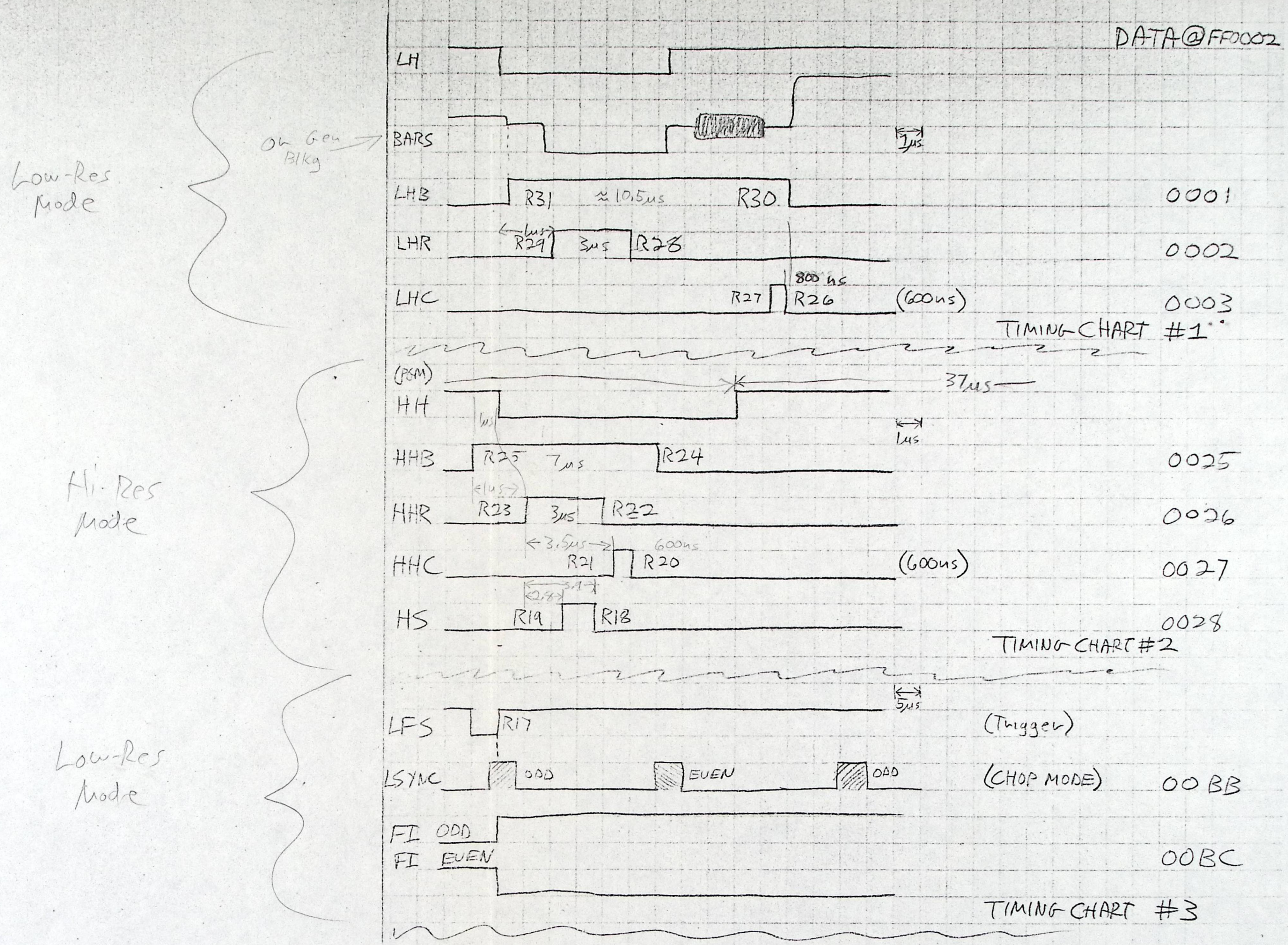
#	P-2#	DESCRIPTION	REMARKS	
0	n/a	GND (off)	TO MINIMIZE CROSSTALK	
1	17	DSP (sin)		
2	19	DSP (cos)	BOARD #1	
3	21	HFO		
4	23	HFO		
5	25	DSP (sin)		
6	27	DSP (cos)	BOARD #2	
7	29	HFO		
8	31	HFO		
9	33	DSP (sin)		UNIQUE TO A
10	35	DSP (cos)	BOARD #3	SLAVE CHANNEL
11	37	HFO		
12	39	HFO		
13	41	VERT RAMP	FROM VTB	
14	43	HORIZ. RAMP	FROM VTB	
15	45	Z RAMP	FROM VTB	
16	47	CHANNEL SPARE		
17	38	DSP (sin)		
18	40	DSP (cos)	BOARD #1*	
19	42	HFO		
20	44	HFO		
21	46	DSP (sin)		
22	48	DSP (cos)	BOARD #2*	
23	50	HFO		
24	52	HFO		SHARED BY ALL
25	54	EXT IN #1	REAR PANEL	CHANNELS
26	56	EXT IN #2	REAR PANEL	
27	58	EXT IN #3	REAR PANEL	
28	60	VID IN #1	FROM ROUTING	
29	62	VID IN #2	FROM ROUTING	
30	64	VID IN #3	FROM ROUTING	
31	66	VID IN #4	FROM ROUTING	

DSP = DIGITAL SLAVED PAIR OSCILLATOR
HFO = HIGH FREQUENCY OSCILLATOR

* BOARDS TO BE LOCATED IN MASTER CHASSIS

D=0 @FF1000

D=01 @FF1004
D=1FF @FF1020
D=01 @FF1000

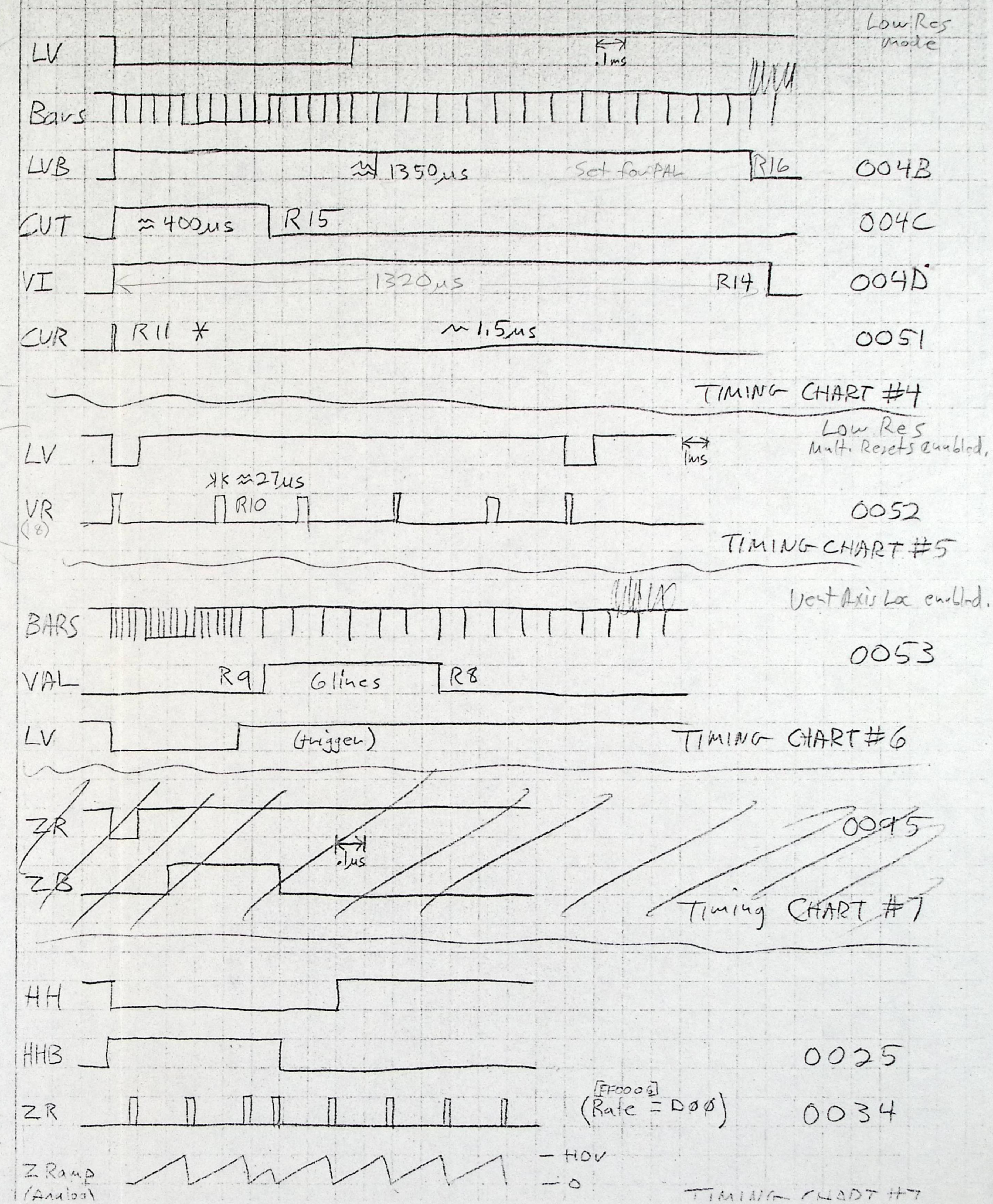


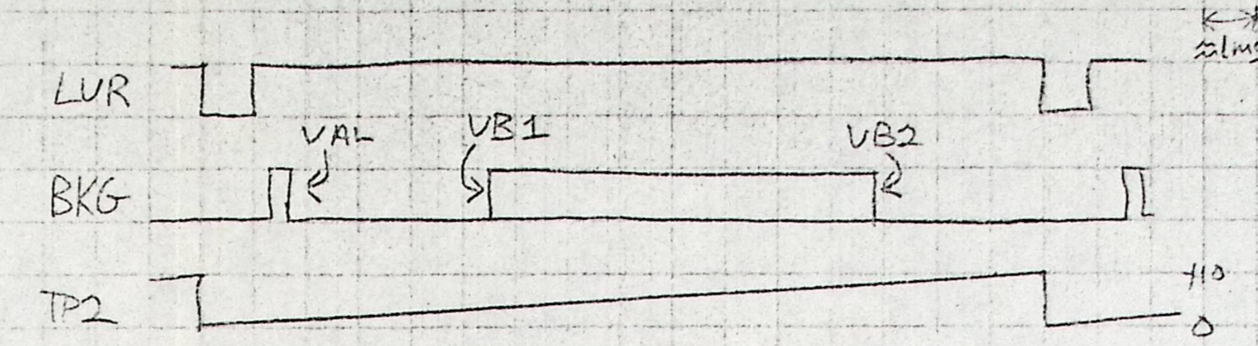
Low-Res mode

Do at end of P3

D=04.@FF1000 on-sync

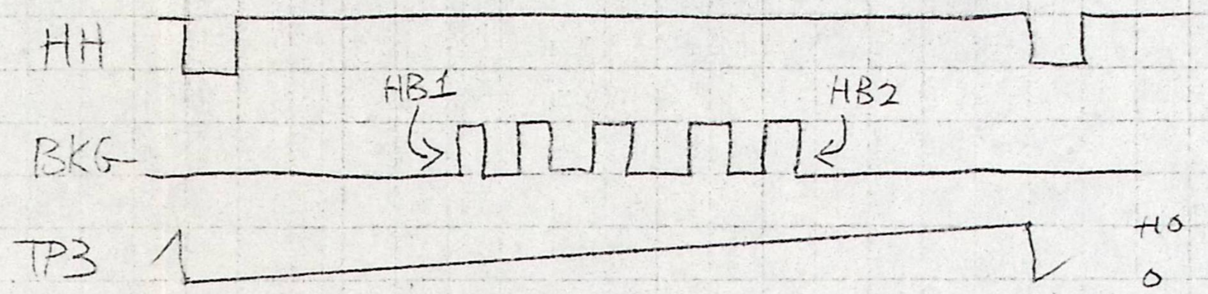
DE05





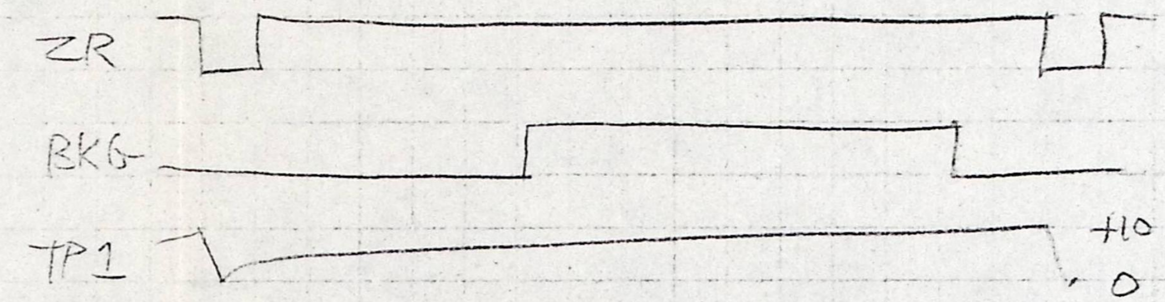
0056

Timing Chart #8



0036

Timing Chart #9

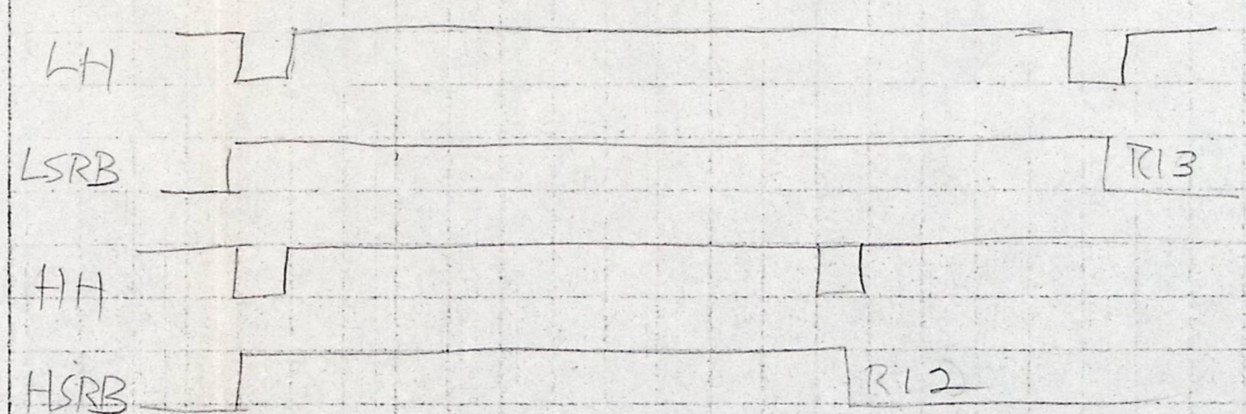


0096

Timing Chart #10

D@FF1020 = 7F
D@FF1022 = 1FF
D@FF1000 = 2

D@FF1000 = 3



DO Chart 5 P2

VTB-102B SETUP

(DO MODS FIRST)

---INSTALL JUMPERS AT J1 + J3, BE CERTAIN CHASSIS HAS SYNC AND DRIVES CONNECTED AND TERMINATED AT REAR PANEL, AND THAT THEY ARE PROPERLY CONNECTED TO SLOT 1 P2 STARTING AT PIN 18.

---SET SW-4 ALL OFF BUT #5.

---POWER UP, RUN RAMP PROGRAM, CHECK FOR RAMPS AT PIN 15 O DAC'S:

U-86	ADDRESS = FF0040
U-85	FF0060
U-22	FF0080
U-87	FF00A0
U-23	FF00C0
U-24	FF00E0

---CHECK FOR TTL LEVEL SYNC DRIVES AT U-88 PINS 12, 14, 16.

AT FF0000 PUT DATA: 00F2
---SHOULD GET Z RAMP AT TP-1, H RAMP AT TP-3.

AT FF0002 PUT DATA: 0000
---SHOULD GET LORES HORIZ DRIVE AT TP-4 + 5 (INVERTED AT 5). SET SCOPE TO TRIGGER + FROM TP-5 UPPER TRACE, DISPLAY HOUSE BARS LOWER.

AT FF0002 PUT DATA: 0001
---ADJUST R-30 (LH BLANKING WIDTH) AND R-31 (LH BLANKING START POSITION). SEE TIMING CHART #1.

AT FF0002 PUT DATA: 0002
---ADJUST R-29 + 28 (SEE TIMING CHART #1).

AT FF0002 PUT DATA: 0003
---ADJUST R-26 + 27 (SEE TIMING CHART #1).

AT FF0000 PUT DATA: 00F3

AT FF0002 PUT DATA: 0025

SET SW 1, 2, 3 AS FOLLOWS:

SW 1	SW 2	SW 3
ON	OFF	OFF
OFF /13	OFF /3	ON /14
ON	ON	OFF
OFF	ON	OFF

---29,304 = 34us
---TRIG VERT X10
---ADJ R-11 FOR STAB.
---TRIGGER + TP-5, SCOPE TP-4, SET R-25 FOR 1us FRONT PORCH (SEE TIMING CHART #2), SET R-24 FOR 7us BLANKING WIDTH (SEE TIMING CHART #2), SET RESET, CLAMP + SAMPLE BY CHART #2.

AT FF0002 ENTER DATA: 00BB
---TRIGGER - FROM TP-4 UPPER TRACE, SCOPE TP-5 LOWER TRACE.
---SET R-17 AS PER TIMING CHART #3.

AT FF0002 ENTER DATA: 00BC
---CHECK FOR WAVEFORM PER CHART #3.

AT FF0002 ENTER DATA: 004B
---TRIGGER - FROM TP-4, SCOPE BARS UPPER TRACE, AND TP-5 LOWER TRACE.
---ADJUST R-16 TO END VERTICAL BLANKING JUST BEFORE START OF VIDEO ON BARS (SEE CHART #4).

AT FF0002 ENTER DATA: 004C
---ADJUST R-15 AS PER CHART #4.

AT FF0002 ENTER DATA: 004D
---ADJUST R-14 AS PER CHART.

AT FF0002 ENTER DATA: 0051
---VERIFY TIMING AS PER CHART.

AT FF0000 ENTER DATA: 00F3

AT FF0020 ENTER DATA: 4B VIA REPEAT PGM.

AT FF0004 ENTER DATA: 00

AT FF0002 ENTER DATA: 52
---VERIFY MULTIPLE VERTICAL RESETS SIMILAR TO CHART #5.
---TRIGGER - ON LOWER TRACE FROM TP-4, VR.

AT FF0002 ENTER DATA: 44
---ADJUST R-11 UNTIL TOP TRACE LOCKS (X10 MAG).
---SET R-11 IN CENTER OF LOCK RANGE.

AT FF0002 ENTER DATA: 32
---ADJUST R-10 TO MAKE TRAILING EDGES EQUAL.

AT FF0002 ENTER DATA: 30
---ADJUST R-12 TO MAKE TRAILING EDGES OF BOTH PULSES EQUAL.

AT FF0002 ENTER DATA: 0F

AT FF0000 ENTER DATA: F2
---ADJUST R-13 AS ABOVE (FALLING EDGE EQUAL).

AT FF0000 ENTER DATA: F7

```
AT FF0002 ENTER DATA:  53
         ---ADJUST R-8 + R-9 AS PER CHART #6.

AT FF0000 ENTER DATA:  F7

AT FF0002 ENTER DATA:  34
         ---TRIGGER + FROM TP-5, VERIFY 100us PULSE.
         ---TRIGGER - FROM TP-4, SET SCOPE TO DISPLAY 1HH PERIOD.
         ---VERIFY THAT TP-5 SIGNAL REMAINS LOCKED.

AT FF0006 ENTER DATA:  00
         ---VERIFY AT LEAST 50 (LIKELY 75) PULSES PER HIRES H.

AT FF0006 ENTER DATA:  FFF
         ---VERIFY NO PULSES.

AT FF0006 ENTER DATA:  D00
         ---VERIFY 11 PULSES PER "ON" TIME OF HH.

AT FF0002 ENTER DATA:  34
         ---VERIFY AS PER TIMING CHART #7.


USING REPEAT PROGRAM, ENTER THE FOLLOWING DATA AT THESE ADDRESSES:

         @ FF0020  000
         @ FF0040  200
         @ FF0060  D00
         @ FF0080  200
         @ FF00A0  D00
         @ FF00C0  200
         @ FF00E0  D00


USING VERSABUG RO SET MODES:

         @ FF0000   95
         @ FF0002   56
         @ FF0004  000
         @ FF0006  D00


---TRIGGER - FROM TP-4, CHECK TP-5 UPPER TRACE, TP-2 LOWER.  ADJUST R-86, VERIFY
  THAT AMPLITUDE OF RAMP AFFECTS TIMING OF VB-1 AND VB-2. SEE TIMING CHART #8.
  SET R-86 SO RAMP GOES 0 TO +10 V.


AT FF0000 ENTER DATA:  91
         ---VERIFY THAT VAL PULSE DISAPPEARS.

AT FF0000 ENTER DATA:  9D
         ---VERIFY THAT ALL BLANKING GOES TO ZERO.

AT FF0000 ENTER DATA:  95

AT FF0002 ENTER DATA:  36
         ---CHANGE SCOPE PROBE FROM TP-2 TO TP-3.
```

---CHANGE SCOPE RATE TO 5us/CM.
---ADJUST R-74, VERIFY THAT AMPLITUDE OF RAMP AFFECTS TIMING OF HB-1 AND HB-2. SEE TIMING CHART #9.
---SET R-74 SO RAMP GOES ZERO TO +10 V.

AT FF0002 ENTER DATA: 96
---MOVE SCOPE PROBE TO TP-1 FROM TP-3.
---VERIFY AS PER TIMING CHART #10.

AT FF0000 ENTER DATA: 85
---VERIFY Z RAMP GOES TO ZERO.

---CHECK FOR LOW-RES BLANKING AT P2-88, CAMERA VERT. TRIGGER AT P2-26, CAMERA HOR. TRIGGER AT P2-28, CAMERA BLANKING AT P2-30.

Initialization Table for: VTB (TEST FILE) L1

Base = FF1ØØØ

	(MODES)		(SEGLEN)		(+V Blkg)		(-V Blkg)		(+H Blkg)		(-H Blkg)		(+Z Blkg)		(-Z Blkg)
00	C2	20	107	40	0	60	FFF	80	0	A0	FFF	C0	0	E0	FFF
02		22	20	42		62		82		A2		C2		E2	
04	1	24	20	44		64		84		A4		C4		E4	
06	FFF	26	20	46		66		86		A6		C6		E6	
08		28	20	48		68		88		A8		C8		E8	
0A		2A	20	4A		6A		8A		AA		CA		EA	
0C		2C	20	4C		6C		8C		AC		CC		EC	
0E		2E	20	4E		6E		8E		AE		CE		EE	
10		30	20	50	FFF	70	FFF	90	FFF	B0	FFF	D0	FFF	F0	FFF
12		32	20	52	0	72	0	92	0	B2	0	D2	0	F2	0
14		34	20	54		74		94		B4		D4		F4	
16		36	20	56		76		96		B6		D6		F6	
18		38	20	58		78		98		B8		D8		F8	
1A		3A	20	5A		7A		9A		BA		DA		FA	
1C		3C	20	5C		7C		9C		BC		DC		FC	
1E		3E	20	5E		7E		9E		BE		DE		FE	

Base =

00	20	40	60	80	A0	C0	E0
02	22	42	62	82	A2	C2	E2
04	24	44	64	84	A4	C4	E4
06	26	46	66	86	A6	C6	E6
08	28	48	68	88	A8	C8	E8
0A	2A	4A	6A	8A	AA	CA	EA
0C	2C	4C	6C	8C	AC	CC	EC
0E	2E	4E	6E	8E	AE	CE	EE
10	30	50	70	90	B0	D0	F0
12	32	52	72	92	B2	D2	F2
14	34	54	74	94	B4	D4	F4
16	36	56	76	96	B6	D6	F6
18	38	58	78	98	B8	D8	F8
1A	3A	5A	7A	9A	BA	DA	FA
1C	3C	5C	7C	9C	BC	DC	FC
1E	3E	5E	7E	9E	BE	DE	FE

VTB-102B MODS

*PROBLEM: AM0 AND AM2 SIGNALS INCORRECT AT P2.

SOLUTION: CUT TRACES AT P2 81 + 83. SOLDER 2 JUMPERS AS SHOWN:

```
             P1             |------------------------------O   O   O
          COMP SIDE         |                                  |   |
                            |   O------------------------------|   |
                            |                                      |
                            |   -----------------------------------|
         BEFORE:            |   |
                ___TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__
                           81  83  85


                                                    SOLDER TO 85
                                                     <--------\
        X = CUT                                                \
                                               SOLDER TO 83     \
                                                  <------\       \
                                                          \       \
              P1            |------------------------------@   O   @
          COMP SIDE         |                                  |   |
                            |   O------------------------------|   |
                            |                                      |
                   CUT--->  |   -----------------------------------|
         AFTER:             X   X
                ___TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__
                           81  83  85
```

*PROBLEM: INCORRECT TRACES, U-95.

SOLUTION: CUT TRACES 5 PLACES, ADD 1 JUMPER:

```
        U-95 COMPONENT SIDE:                          U-95 TRACE SIDE:

         ----------                |        |   X
  O---X--|O      O|   X = CUT      |        |   |   O
         |        |                |        |   |  | |
---------|O      O|                |    O   |   |   O
         |        |                |        |   |
---------|O      O|                X    O   |   |   O-----|
         |        |                |        |   |         |
---------|O      O|                |    O   |   |---O     |
         |        |                |        |             |
O--------|O      O|                |    O   |       O--|  |
         |        |                |        |          |  |
------X--|O      O|                |----O   |-------O  |  |
         |        |                                    |  |
---------|O      O|                     O           O  |  |
         |        |                                    |  |
---------|O      O|                     O           O  |  |
         |        |                                    |  |
------X--|O      O|                     O           O  |  |
         |        |
---------|O      O|                     O           O
         |        |
         ----------                     O           O
```

ADD JUMPER, U-95 PIN 3 TO
U-79 PIN 12.

*PROBLEM: OMITTED PULLUP RESISTOR, U-43.

SOLUTION: ADD 2.2K 1/4W RESISTOR BETWEEN PINS 14 + 8 REAR OF BOARD.

*PROBLEM: BLANK-OFF LED TRACE OMITTED.

SOLUTION: ADD JUMPER, U-34 PIN 13 TO U-70 PIN 11.

*PROBLEM: LORES H BLANKING RANGE INSUFFICIENT.

SOLUTION: REPLACE R-32 WITH 33K 1/4W 5%.
REPLACE R-33 WITH 12K 1/4W 5%.
CUT 2 TRACES, ADD 2 JUMPERS REAR SIDE OF U-5 AS SHOWN:

```
  -------------------------------------------------------------
  BOARD EDGE

                         ----------------
                         |          \   |
         U-5             |           J  |      <---ADD
         REAR            |          /   X    <---CUT
                         |      ||==O   |
                         |      ||      |
                     O   |      ||  O\---|
    X = CUT              |      ||    J     <---ADD
                     O   |      XX  O/    <---CUT
   \                     |      ||
    J = ADD          O   |      ||  O
   /   JUMPER            |      ||
                     O   |      ||  O
                         |      ||
                     O   |      ||  O
                         |      ||
                     O   |      ||  O
                         |      ||
                     O   |      ||==O
                         |
                         O
```

*PROBLEM: LORES H CLAMP POS. INADEQUATE RANGE.

SOLUTION: CHANGE R-97 TO 27K 1/4W 5%.

*PROBLEM: HIRES H BLANKING WIDTH INADEQUATE RANGE.

SOLUTION: CHANGE R-56 TO 15K 1/4W 5%.

*PROBLEM: LSYNC AND FI TEST TRACES OMITTED.

SOLUTION: RUN JUMPER FROM U-45 PIN 2 TO U-31 PIN 20, AND FROM U-45 PIN 6 TO U-31 PIN 19.

*PROBLEM: TRIGGER SENSE REVERSED, U-17.

SOLUTION: CUT 2 TRACES, ADD 2 JUMPERS:

```
       U-17 COMP SIDE                    U-17 TRACE SIDE
         __________
         | C 27   |
         |________|                  O    /------O
         ||                               J              <---ADD
 CUT---> XX                               \
         ||__________                O     |---X---O\    <---CUT
         |          |    X = CUT           |         J   <---ADD
         |          |                      |        /
         |          |   \                O |       O================
         |          |    J = ADD           |
         |          |   /   JUMPER         |
         |          |                O     |       O
         |          |                      |
         |          |                      |
         |          |                O     |       O
                                           |
```

*PROBLEM: V BLANK RANGE INADEQUATE.

SOLUTION: PARALLEL .1uf ACROSS C-26, CHANGE PARTS LIST TO .22

*PROBLEM: CHANGE SECTION RESET FROM ABSOLUTE LINE # TO # LINES PER SECTION.

SOLUTION: CUT 2 TRACES, ADD 2 JUMPERS:

```
                    TRACE SIDE                    COMP SIDE
  X = CUT

  /                 0   U-26  0
 J  = ADD                                         ..........
  \  JUMPER         0         0                   |        |
                         ||                       |        |
                    0    ||   0                   |  U-26  |
                         ||                       |        |
                    0    ||   0                   |        |
                         ||                       |        |
                    0    ||   0                   |        |
         /----------------||                      |        |=====X====0    <---CUT
ADD--->  J          0    ||   0                   |        |
         \               ||                       |        |
         @        /-@==X=||   0    <---CUT        |        |             0
         ||       J                 <---ADD       |        |
         ||       \  0        0                   |        |
   0     ||    0  |                               |........|        0
         ||       |  0        0
         ||       |
         ||       V
         ||    U-14 PIN 13
         ||
```

*PROBLEM: HIRES/NORM VERT REVERSED.

SOLUTION: CUT 3 TRACES, ADD 3 JUMPERS:

```
         COMP SIDE                    |  |  |||              |     SOLDER SIDE
                             }        |  |  |||              |______
 .........          ADD      }        |  |  |||               _______>0
 |       |     CUT   |       }   /    X   \\\    <---CUT     |
 |       |      |    V      |}   |    |    |||               |   |---X---0   <---CUT
 |       |      V           |}   |    0    |||               |   |
 |       |                  |}   |         |||               |   |__/J\__0   <---ADD TO HOLE
 | U-62  |------------0\  0-|}   |         |||               |   |           RIGHT OF U-44
 |       |            J      }   |         |||               |   |   0
 |       |-----X-----/_______}___|         |||               |   |
 |       |                   }             ||                |   |   0
 |       |----0              }             |                     |
 |       |                   }                                   |
 |       |                   }                                   |   0
 |       |---0               }         X = CUT                   |
 |       |                   }                                   |   0
 |       |      0----------- }         \                         |
 |.......|                   }          J = ADD                      0
                                       /    JUMPER
```

*PROBLEM: HSRB TIMING TOO SHORT.

SOLUTION: REPLACE R-48 WITH 4.7K 1/4W 5%.

*PROBLEM: LSRB TIMING TOO SHORT.

SOLUTION: REPLACE R-49 WITH 15K 1/4W 5%.

*PROBLEM: VR PULSE TOO LONG.

SOLUTION: REPLACE C-17 WITH .01uf TS CAP.

*PROBLEM: ZR PULSE TOO SHORT.

SOLUTION: REPLACE R-79 WITH 4.7K 1/4W 5%.

*PROBLEM: ZR TIMING TOO EARLY.

SOLUTION: CUT 1 TRACE, ADD 1 JUMPER:

```
         REAR OF BOARD:
                                              <---ADD TO U-89 PIN 14
                               CUT--->
   X = CUT                             X    J   |------------------->
                   0         0         @---/ \--| 0         0
  \                   U-45                          U-44
   J = ADD         0         0                    0         0
  /   JUMPER                           0
                   0         0                    0         0

                   0         0                    0         0
```

*PROBLEM: Z RAMP FWR BLANKING INCORRECT.

SOLUTION: CUT 1 TRACE, RUN 1 JUMPER:

```
                                                                J
                                                   X = CUT     / \ = ADD JUMPER
         FRONT OF  |  U-12  |
         BOARD:    | BOTTOM |
                   ----------                  RUN JUMPER ON TRACE SIDE
                         J      <---ADD        TO U-62 PIN 9.
             CUT--->   X / \------------------------------------------->
                        @
```

*PROBLEM: VERTICAL RESET NOT FULLY DISCHARGING C117.

SOLUTION: JUMPER U-84 PIN 9 TO 13, PIN 1 TO 7, PIN 14 TO 8.(PARALLEL SWITCHES)

*PROBLEM: TEST SWITCHER, TRACE OMITTED, CRT BLANKING.

SOLUTION: ADD 1 JUMPER, U-31 PIN 2 TO U-70 PIN 6.

*PROBLEM: DISABLED Z RAMP OSCILLATES.

SOLUTION: CUT 1 TRACE, ADD 3 JUMPERS, 1 RESISTOR:

```
   FRONT           ----------
                   |        |       ---JUMPER FROM HOLE "A" TO U-33 PIN 11;
                   |  U-50  |       ---JUMPER FROM U-33 PIN 12 TO U-52 PIN 4;
             O-----|        |       ---INSTALL 270 ohms RES. U-34 PIN 2 TO
HOLE               |        |          U-52 PIN 3;
 "A"--->  O---X----|        |       ---JUMPER U-34 PIN 2 TO U-33 PIN 13, AND
      CUT--->      |        |          U-34 PIN 1 TO U-62 PIN 9.
                   |        |
 X = CUT           |________|
```

*PROBLEM: LHC CLAMPS WRONG DURING VERTICAL.

SOLUTION: CUT U-20 PINS 10 + 11 FREE (REAR OF BOARD).
ADD JUMPER TO ~~U-17 PIN 12.~~
U-34 PIN 4. Add jumper from U62 pin 3 to U34 pin 3. Add 3.3K from U34 pin 4 to U34 pin 14.

ok 5/12

*PROBLEM: V + H BLANKING COMPARATORS OSCILLATE.

SOLUTION: PUT 27K ohms 1/4W 2% IN PARALLEL WITH 5pf CAPS BETWEEN PINS 3 + 11
OF U-72, 73, 21, 35, 3, 11.
CHANGE C-1 FROM 1uf TO 10uf:

```
                     O         __________________
                              |                  |          X = CUT
                         O    |   U-44           |
                              |                  |
                         O    |                  |
                              |                  |
      CUT-->          O==X====|                  |
                              |                  |
                         O    |__________________|
```

*PROBLEM: Z RAMP RANGE.

SOLUTION: CHANGE C-81 TO 56pf.
SWAP C-83 FOR 470 ohms.

*PROBLEM: Z RESET LEFT OFF.

SOLUTION: CUT TRACE FROM 13 OF U-52 TO 15 OF U-71.
JUMPER FROM U-33 PIN 11 TO 15 OF U-71.

*PROBLEM: WHITE PULSE LEFT OFF BOARD.

SOLUTION: WIRE FROM U-62 PIN 9 TO U-43 PINS 1 + 2.
WIRE FROM U-43 PIN 3 TO P2 - 93 (COMP SIDE):

```
                                        |
                                        |
                                        O <--THRU HOLE
                                        |
                    O    O    O     //==|=================
         P2         \\       //    //   |
    COMP SIDE  _____TT_____TT_____TT____TT_____TT____________
                                       93
```

*PROBLEM: INTERMITTENT GLITCHES OUT OF U-96 DUE TO DATA STROBE UNDERSHOOT.

SOLUTION: USE ONLY MOTOROLA 74LS260'S IN U-96.

*PROBLEM: BLANKING BUS NOT SUFFICIENTLY DRIVEN BY LS260.

SOLUTION: USE 74S260 IN U-70. CHANGE PARTS LIST.

*PROBLEM: COHU ART CAM WON'T TOLERATE HI/LO RES SWITCHING.

SOLUTION: MAKE IT ALWAYS GET HIRES RESET BY CUTTING TRACE GOING TO PIN 8 OF U-91, (COMP SIDE) JUMPER 8 OF U-91 TO PIN 5 OF U-62.

*PROBLEM: GLITCH

SOLUTION: U-5 ADD 2 CAPACITORS, ADD 1 JUMPER .1uf BETWEEN PIN 3 AND PIN 8, 1000pf BETWEEN PIN 8 AND CLOSEST HOLE TO LEFT, JUMPER U-5 PIN 8 TO U-20 PIN 8:

```
      ____/J\_____
      |           |                   /J\ = ADD JUMPER
O     |     ||=X=O  <---CUT
      |     ||                          X = CUT
O     |     ||    O\
      |     ||      |
O     |     ||    O/\
      |     ||       \
O     |     ||    O    |
      |     ||         |
O     |     ||    O  ___
      |     ||       ___  .1uf 104
O     |     ||    O    |
      |     ||         |
O     |     ||    O   /       <--ADD
      |     ||       /           TO U-20 PIN 8
O     |     ||===O-----/J\------------------->
      |           |
      |---O---|  |-|

            1000pf
             102
```

*PROBLEM: SCAN BAR COUNTER STAYS RESET DURING ENTIRE VERTICAL.

SOLUTION: ADD JUMPER FROM U-17 PIN 13 TO U-46 PIN 11;
CUT TRACE BY U-44 AS SHOWN:

```
                                  __________
                                  |   V    |
      CUT--->       O------X------|        |       COMP SIDE
                     _____________|  U-44  |
                     _____________|        |
                     ---------O   |        |
                     _____________|        |
                                  |________|

      X = CUT
```

*PROBLEM: INSUFFICIENT GROUND.

SOLUTION: ADD JUMPER FROM P1- TO U-90 PIN 8 TO U-63 PIN 8 TO U-44 PIN 8 TO
U-27 PIN 8 TO U-18 PIN 8 TO C30-.1uf ABOVE U-18.

```
                          |
          ADD--->        /                                    /
                         J                                    J = ADD JUMPER
                         \                                    \
________________          |
       |        |        |
  ______        |      T|T    T T
       |        |      |O|    |O|    __________
       |        O      | |    | |    |         |              SOLDER SIDE
       |               |O|    |O|    |         |
 P1  ___TT_____TT______| |____| |____|         |___TT___TT___TT___TT       P2
```

*PROBLEM: J2 CONNECTED INCORRECTLY.

SOLUTION: CUT TRACE BETWEEN PINS OF J2.

VTB UPDATED 12-28-82 RW

Stuffing List for VTB100A

Reference No's	Part Name	Part Type	Description
C1 10uf	~~C 1UF 25V~~		No description found in cross ref file
C2	Reference not found in component list 39pf		
C3	Reference not found in component list .1uf		
C4-5	C 39PF 200V		No description found in cross ref file
C6	C 1000PF 200V		No description found in cross ref file
C7	C .01UF 50V		No description found in cross ref file
C8-10	C .1UF 50V		No description found in cross ref file
C11	C 10UF 25V		No description found in cross ref file
C12	Reference not found in component list .1uf		
C13	Reference not found in component list .1uf		
C14-18 NOT C17	C .1UF 50V		No description found in cross ref file C17 – .01uf TS C16 = .22uf
C19	C 100PF 200V		No description found in cross ref file
C20	C .01UF 50V		No description found in cross ref file
C21	C .1UF 50V		No description found in cross ref file
C22	C .01UF 50V		No description found in cross ref file
C23	C 1UF 25V		No description found in cross ref file
C24-27 NOT 26	C .1UF 50V		No description found in cross ref file → C26 – .22uf
C28	C 1000PF 200V		No description found in cross ref file
C29	C 100PF 200V		No description found in cross ref file
C30	C .1UF 50V		No description found in cross ref file
C31-32	C 1000PF 200V		No description found in cross ref file
C33	C .1UF 50V		No description found in cross ref file
C34	C .01UF 50V		No description found in cross ref file
C35	C 100PF 200V		No description found in cross ref file
C36	C .1UF 50V		No description found in cross ref file
C37	Reference not found in component list .1uf		
C38-46	C 1UF 25V		No description found in cross ref file
C47-48	C .1UF 50V		No description found in cross ref file
C49	C 1000PF 200V		No description found in cross ref file
C50	C .1UF 50V		No description found in cross ref file
C51	C 100PF 200V		No description found in cross ref file
C52	C 1000PF 200V		No description found in cross ref file
C53	C .1UF 50V		No description found in cross ref file
C54 OMITED	Reference not found in component list		
C55	C 100PF 200V		No description found in cross ref file
C56	C 1000PF 200V		No description found in cross ref file
C57	C .1UF 50V		No description found in cross ref file
C58	C 100PF 200V		No description found in cross ref file
C59-68	C .1UF 50V		No description found in cross ref file
C69	Reference not found in component list .1uf		
C70-76	C .1UF 50V		No description found in cross ref file
C77	C 1UF 25V		No description found in cross ref file
C78	C .1UF 50V		No description found in cross ref file
C79-80	C 1UF 25V		No description found in cross ref file
~~C81~~-83, 82	C .1UF 50V		No description found in cross ref file
C84	C 39PF 200V		No description found in cross ref file
C85	C .1UF 50V		No description found in cross ref file
C86	C 39PF 200V		No description found in cross ref file
C87-88	C 560PF 200V		No description found in cross ref file
C89-108	C .1UF 50V		No description found in cross ref file
C109	Reference not found in component list .1uf		
C110-115	C .1UF 50V		No description found in cross ref file
C116	Reference not found in component list .1uf		
C81	18pf		

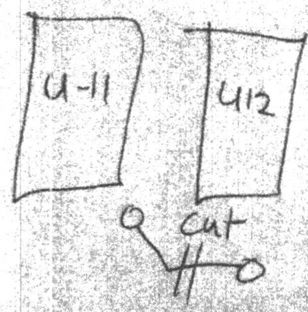
Reference No's	Part Name	Part Type	Description
C117	C .1UF 50V		No description found in cross ref file
C118-126	C 1UF 25V		No description found in cross ref file
C127-138	C .1UF 50V		No description found in cross ref file
C139	C 1000PF 200V		No description found in cross ref file
CR1-9	1N914	DIODE	SWITCHING DIODE
LED1	LED RED 90 DEG		No description found in cross ref file
LED2	LED GREEN 90 DEG		No description found in cross ref file
R1	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R2	R 15K OHM 1/4W 2%	RESISTOR	15K 1/4W 2% RESISTOR
R3	R 10 OHM 1/4W 2%	RESISTOR	10 1/4W 2% RESISTOR
R4-5	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R6	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R7	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R8-10	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R11	RV 50K BOURNS 3006	POT	50K 3006 10 TURN PC POT
R12-15	RV 5K BOURNS 3006	POT	5K 3006 10 TURN PC POT
R16	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R17	Reference not found in component list		
R18	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R19	RV 50K BOURNS 3006	POT	50K 3006 10 TURN PC POT
R20-22	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R23	RV 50K BOURNS 3006	POT	50K 3006 10 TURN PC POT
R24-28	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R29	RV 50K BOURNS 3006	POT	50K 3006 10 TURN PC POT
R30-31	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R32 - 33K	~~R 4.75K~~ OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R33 - 12K	~~R 475 OHM~~ 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R34-35	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R36	R 47.5K OHM 1/4W 2%	RESISTOR	47.5K 1/4W 2% RESISTOR
R37-38	R 75K OHM 1/4W 2%	RESISTOR	75K 1/4W 2% RESISTOR
R39	R 47.5K OHM 1/4W 2%	RESISTOR	47.5K 1/4W 2% RESISTOR
R40	R 75K OHM 1/4W 2%	RESISTOR	75K 1/4W 2% RESISTOR
R41-42	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R43-OMIT	R 2.2K OHM 1/4W 2%	RESISTOR	2.2K 1/4W 2% RESISTOR
R44	R 1.5K OHM 1/4W 2%	RESISTOR	1.5K 1/4W 2% RESISTOR
R45	R 2.2K OHM 1/4W 2%	RESISTOR	2.2K 1/4W 2% RESISTOR
R46	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R47	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R48 - 4.7K	~~R 1.5K OHM~~ 1/4W 2%	RESISTOR	1.5K 1/4W 2% RESISTOR
R49-15K	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R50	R 2.2K OHM 1/4W 2%	RESISTOR	2.2K 1/4W 2% RESISTOR
R51	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R52	R 15K OHM 1/4W 2%	RESISTOR	15K 1/4W 2% RESISTOR
R53	R 8.2K OHM 1/4W 2%	RESISTOR	8.2K 1/4W 2% RESISTOR
R54-~~56~~55	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R57	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R58	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR

R56 - 15K

Reference No's	Part Name	Part Type	Description
R59-61	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R62	R 3.3K OHM 1/4W 2%	RESISTOR	3.3K OHM 1/4W 2% RESISTOR
R63	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R64	R 3.3K OHM 1/4W 2%	RESISTOR	3.3K OHM 1/4W 2% RESISTOR
R65	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R66-67	R 2.2K OHM 1/4W 2%	RESISTOR	2.2K 1/4W 2% RESISTOR
R68-69	R 332 OHM 1/4W 2%	RESISTOR	332 1/4W 2% RESISTOR
R70-72	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R73	R 15K OHM 1/4W 2%	RESISTOR	15K 1/4W 2% RESISTOR
R74	RV 10K BOURNS 3329	POT	10K 3329 ROUND-TOP ADJUST POT
R75 2.2K	Reference not found in component list		
R76	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R77	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R78	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R79 - 4.7K	~~R 2.2K~~ OHM 1/4W 2%	RESISTOR	2.2K 1/4W 2% RESISTOR
R80	R 10 OHM 1/4W 2%	RESISTOR	10 1/4W 2% RESISTOR
R81-84	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R85	R 150K OHM 1/4W 2%	RESISTOR	150K 1/4W 2% RESISTOR
R86	RV 10K BOURNS 3329	POT	10K 3329 ROUND-TOP ADJUST POT
R87	R 10 OHM 1/4W 2%	RESISTOR	10 1/4W 2% RESISTOR
R88	R 332 OHM 1/4W 2%	RESISTOR	332 1/4W 2% RESISTOR
R89	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R90	R 332 OHM 1/4W 2%	RESISTOR	332 1/4W 2% RESISTOR
R91	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R92	R 332 OHM 1/4W 2%	RESISTOR	332 1/4W 2% RESISTOR
R93	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R94	R 332 OHM 1/4W 2%	RESISTOR	332 1/4W 2% RESISTOR
R95	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R96 4.7K	Reference not found in component list		
R97 27K	~~R 4.75K~~ OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
RP1-3	RP 2K OHM SIP-8		No description found in cross ref file
SU1-240	SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL SOCKET
SU241-375	SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL SOCKET
SU376-430	SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL SOCKET
SW1-3	SW DIP-4	SWITCH	4 POSITION DIP SWITCH
SW4	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
TP1	TEST POINT	HARDWARE	BOARD TEST POINTS
U1	AH0134	IC	DUAL ANALOG SWITCH
U2	LH0062	IC	FET OP-AMP
U3	NE527		No description found in cross ref file
U4-5	74123		No description found in cross ref file
U6-8	DM8520		No description found in cross ref file
U9	LH0062	IC	FET OP-AMP

Reference No's	Part Name	Part Type	Description
U10	MC34002P		No description found in cross ref file
U11	NE527		No description found in cross ref file
U12	7433	IC	QUAD 2-INPUT NOR BUFFERS W/OC OUTPUTS
U13-20	74123		No description found in cross ref file
U21	NE527		No description found in cross ref file
U22-24	AD DAC-80 CB1V		No description found in cross ref file
U25	DM8130		No description found in cross ref file
U26	CD4040		No description found in cross ref file
U27-29	74123		No description found in cross ref file
U30-31	74150		No description found in cross ref file
U32	7428 – 74LS02		No description found in cross ref file
U33	7400		No description found in cross ref file
U34	7416		No description found in cross ref file
U35	NE527		No description found in cross ref file
U36-42	DM8599	IC	16X4 RAM
U43	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U44-45	74S74	IC	DUAL D FLIP-FLOP
U46	CD4040		No description found in cross ref file
U47-48	74LS377	IC	OCTAL REGISTER WITH ENABLE
U49	AD DAC-80 CB1V		No description found in cross ref file
U50	7428 – 74LS02		No description found in cross ref file
U51	CD4046		No description found in cross ref file
U52	74123		No description found in cross ref file
U53	LH0062	IC	FET OP-AMP
U54	AH0134	IC	DUAL ANALOG SWITCH
U55-61	DM8599	IC	16X4 RAM
U62-63	25LS157		No description found in cross ref file
U64	DM8130		No description found in cross ref file
U65-68	74LS377	IC	OCTAL REGISTER WITH ENABLE
U69	7427		No description found in cross ref file
U70	~~74LS260~~ 74S260	IC	DUAL 5-INPUT NOR GATE
U71	74151		No description found in cross ref file
U72-73	NE527		No description found in cross ref file
U74-80	DM8599	IC	16X4 RAM
U81-82	74LS138	IC	3-TO-8 LINE DECODER
U83	LH0062	IC	FET OP-AMP
U84	AH0134	IC	DUAL ANALOG SWITCH
U85-87	AD DAC-80 CB1V		No description found in cross ref file
U88	74LS240	IC	OCTAL BUS DRIVER
U89	74S240	IC	OCTAL BUS DRIVER
U90	74161		No description found in cross ref file
U91	74S240	IC	OCTAL BUS DRIVER
U92	Reference not found in component list		
U93-94	74LS240	IC	OCTAL BUS DRIVER
U95 – 74LS244	Reference not found in component list		
U96	74LS260	IC	DUAL 5-INPUT NOR GATE
U97	74LS240	IC	OCTAL BUS DRIVER
U98-99	25LS2521	IC	8 BIT COMPARATOR

√VTB Mod- cut trace ~~[illegible] U24 pin [illegible]~~



Jump U24 pin 15
to P2-31

ENGINEERING CHANGE NOTICE ECN# 009

MODEL # VFX PAGE 1 OF 1

PART/DWG # VRG-100 REV A RELEASE

REQUIRES CHANGES TO: [X] DOCUMENTATION [ ] PARTS

[X] SOFTWARE [ ] PROCEDURES [X] P.C. ARTWORK

REASON FOR ACTION: Vertical Ramp generator was erroneously labelled "X", Horizontal was labelled "Y".

NOTE: ALL "Z" REMAIN UNCHANGED

ACTION REQUIRED: CHANGE HARDWARE AS FOLLOWS:

cut trace entering pin 6 of U-36, U-37, U-38, U-39
connect pin 6 of U-36 to pin 28 of U-78
connect pin 6 of U-37 to pin 28 of U-79
connect pin 6 of U-38 to pin 28 of U-76
connect pin 6 of U-39 to pin 28 of U-77

CHANGE SCHEMATIC AS FOLLOWS:

change all signal names with X prefix to Y
change all signal names with Y prefix to X

CHANGE ADDRESS MAP AS FOLLOWS:

FF14ØØ	Y SIZE AMPL	FF146Ø	Y AXIS AMPL.
FF142Ø	X SIZE AMPL	FF148Ø	X AXIS AMPL.
FF14CØ	Y SIZE OFFSET	FF14EØ	Y AXIS OFFSET
FF15ØØ	X SIZE OFFSET	FF152Ø	X AXIS OFFSET

NOTE: ALL CONNECT REGISTER BIT ASSIGNMENTS UNCHANGED.

CHANGE BACKPLANE WIRING AS FOLLOWS:

Remove wire from 52-59 to 53-59 (RESCAN CHASSIS ONLY)
Remove wire from 52-55 to 53-55
Add wire from 52-55 to 53-59
Add wire from 52-59 to 53-55

EFFECTIVITY Modify Rev A Boards

[X] IMMEDIATE

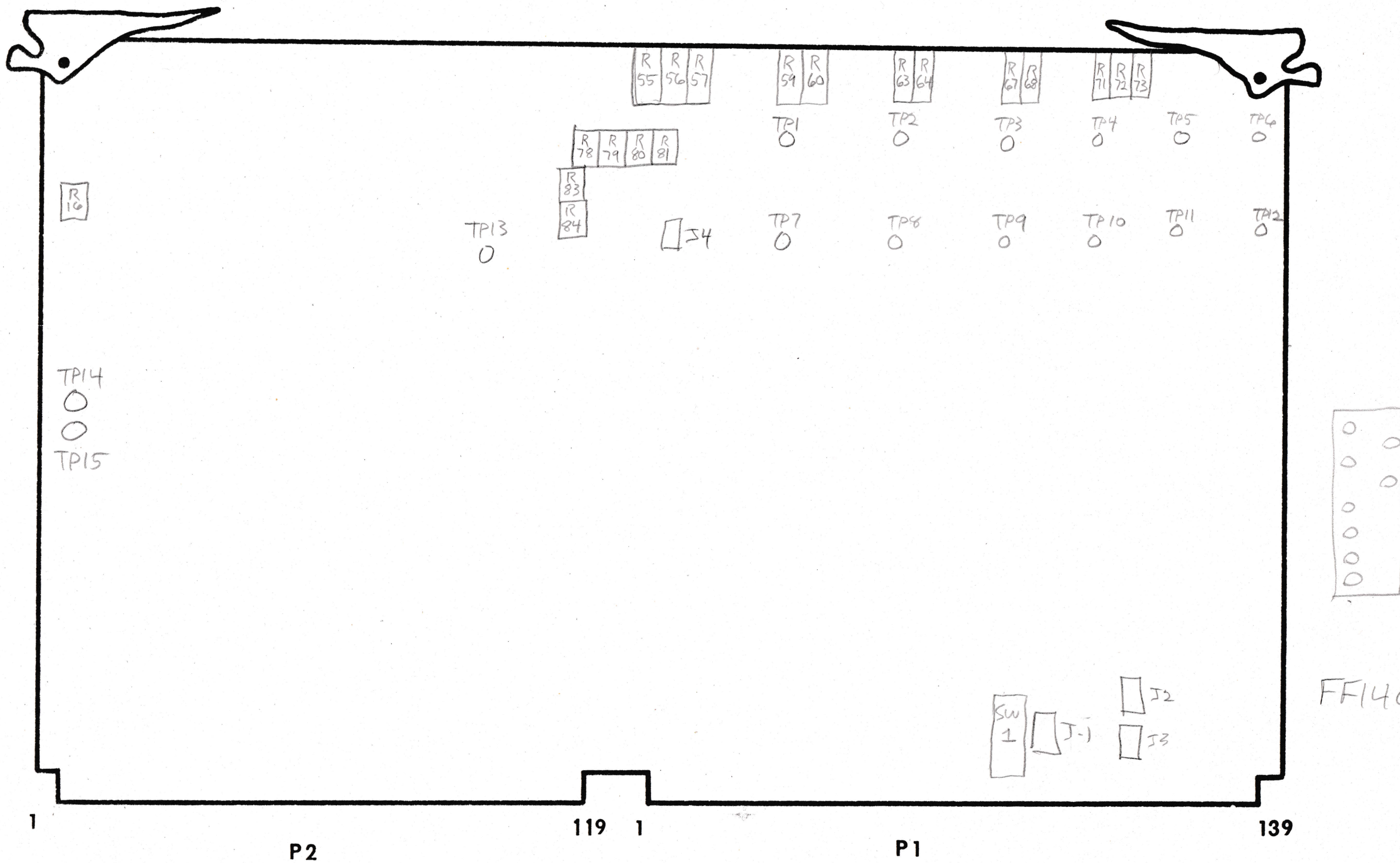
[ ] AFTER SER.#

[ ] AS OF

	SIGNATURES	DATE
ORIGINATOR	DWSieg	10/12/83
PROJ. MGR.	DWSieg	10/12/83

BOARD VRG-100 A **VER.** ______

+15 200ma
-15 400ma



FF1400

VRG Current cons.

+15V 203 ma
-15V 388 ma } all zeroed

$$
\begin{array}{r}
309 \\
-106 \\
\hline
203
\end{array}
$$

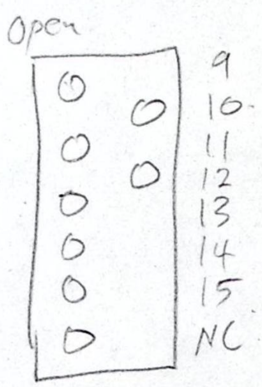
$$
\begin{array}{r}
624 \\
-226 \\
\hline
388
\end{array}
$$

RESCAN CHANNEL: ALL PARAMETERS CAN EFFECT AS MANY AS SIXTEEN RASTER SEGMENTS OF VARIABLE LENGTH AT A TIME.

FLYING SPOT CHANNEL: ALL PARAMETERS EFFECT THE ENTIRE RASTER. NO SEGMENTING IS AVAILABLE.

	OFFSET	AMPLITUDE	CONNECTION
X AXIS	0 - 4095	0 - 4095	0 - 31
Y AXIX	0 - 4095	0 - 4095	0 - 31
Z AXIS	0 - 4095	0 - 4095	0 - 31
X SIZE	0 - 4095	0 - 4095	0 - 31
Y SIZE	0 - 4095	0 - 4095	0 - 31
Z SIZE	0 - 4095	0 - 4095	0 - 31

FF1400



SW1

1. 16 bits x 16

0-4 X SIZE
5-9 Y SIZE
10-14 Z SIZE

2 16 bits x 16

0-4 X AXIS
5-9 Y AXIS
10-14 Z AXIS

BASE ADDRESS
BITS 9-15
AM Ø → LOW
1 — HIGH OR LOW
→ SUPERVISOR MODE ←

JUMPER FOR WRITING TO PARAMETERS
(1) ONLY DURING VERTICAL
(2) ANYTIME

~~(Set FF1020 to 3FF)~~

ADDRESSING

BITS	
1-4	1 of 16 segments
5-8	1 of 13 addresses

	8765	
FF1400	0000	X SIZE AMPLITUDE
1420	0001	Y SIZE AMPLITUDE
1440	0010	Z SIZE AMPLITUDE
1460	0011	X AXIS AMPLITUDE
1480	0100	Y AXIS AMPLITUDE
14A0	0101	Z AXIS AMPLITUDE
14C0	0110	X SIZE OFFSET
14E0	111	X AXIS OFFSET
1500	1000	Y SIZE OFFSET
1520	1001	Y AXIS OFFSET
1540	1010	Z size off
1560	1011	Z AXIS off
1580	1100	REGISTER 1 CONNECTION
15A0	1101	REGISTER 2 CONNECTION

DTACK ~~5~~ 125 μSEC.

VRG-100A RASTER GENERATOR

VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17	AB1	18	VERT. AXIS OUT @
19	AB2	20	VERT. RASTER OUT @
21	AB3	22	VERT. SIZE OUT @
23	AB4	24	HOR. RASTER OUT @
25	AB5	26	HOR. SIZE OUT @
27	AB6	28	Z RASTER OUT @
29	AB7	30	Z SIZE OUT @
31	AB8	32	AXIS LOC.RAMP IN (H RAMP)@
33	AB9	34	HOR. AXIS OUT @ H AXIS
35	AB10	36	Z AXIS OUT @ Z AXIS
37	AB11	38	AB17
39	AB12	40	AB18
41	AB13	42	AB19
43	AB14	44	AB20
45	AB15	46	AB21
47	AB16	48	AB22
49		50	AB23
51	Z RAMP IN @	52	AB24
53		54	AB25
55	X VECTOR IN @	56	AB26
57		58	AB27
59	Y VECTOR IN @	60	AB28
61		62	AB29
63	Z VECTOR IN @	64	AB30
65		66	AB31
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane. ALL other pins are.

AB1 - AB31 ANALOG BUS LINES

@ = ANALOG SIGNAL

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

ANALOG BUS

#	P-2#	DESCRIPTION	REMARKS	
0	n/a	GND (off)	TO MINIMIZE CROSSTALK	
1	17	DSP (sin)	BOARD #1	UNIQUE TO A SLAVE CHANNEL
2	19	DSP (cos)		
3	21	HFO		
4	23	HFO		
5	25	DSP (sin)	BOARD #2	
6	27	DSP (cos)		
7	29	HFO		
8	31	HFO		
9	33	DSP (sin)	BOARD #3	
10	35	DSP (cos)		
11	37	HFO		
12	39	HFO		
13	41	VERT RAMP	FROM VTB	
14	43	HORIZ. RAMP	FROM VTB	
15	45	Z RAMP	FROM VTB	
16	47	CHANNEL SPARE		
17	38	DSP (sin)	BOARD #1*	SHARED BY ALL CHANNELS
18	40	DSP (cos)		
19	42	HFO		
20	44	HFO		
21	46	DSP (sin)	BOARD #2*	
22	48	DSP (cos)		
23	50	HFO		
24	52	HFO		
25	54	EXT IN #1	REAR PANEL	
26	56	EXT IN #2	REAR PANEL	
27	58	EXT IN #3	REAR PANEL	
28	60	VID IN #1	FROM ROUTING	
29	62	VID IN #2	FROM ROUTING	
30	64	VID IN #3	FROM ROUTING	
31	66	VID IN #4	FROM ROUTING	

DSP = DIGITAL SLAVED PAIR OSCILLATOR
HFO = HIGH FREQUENCY OSCILLATOR

* BOARDS TO BE LOCATED IN MASTER CHASSIS

Remove UVG Board, Power up

VRG SETUP

Load Test, L1.

LOAD 7FF (2047) @ FF1400 - FF15BE.

Set 20H at FF1020

Enable VAL

LOAD 0 @ FF1580 - FF15BE.

~~BE SURE 3FF @ FF1020 (SINGLE SECTION)~~

ZERO ALL DAC'S During section 7 AS PER TABLE 1:

ADDRESS	IC	SCOPE	ADJUST	FUNCTION
FF1400	U30	TP7	R60	V SIZE AMPL.
FF1420	U31	TP8	R64	H SIZE AMPL.
FF1440	U32	TP9	R68	Z SIZE AMPL.
FF1460	U33	TP10	R71	V AXIS AMPL.
FF1480	U34	TP11	R72	H AXIS AMPL.
FF14A0	U35	TP12	R73	Z AXIS AMPL.
FF14C0	U13	TP6	R56	V SIZE
FF14E0	U18	TP1	R59	V AXIS
FF1500	U12	TP5	R55	H SIZE
FF1520	U9	TP2	R63	H AXIS
FF1540	U11	TP4	R57	Z SIZE
FF1560	U10	TP3	R67	Z AXIS
FF1580	D0 - 4	U76 + 94		V SIZE EXT
	D5 - 9	U78 + 96		H SIZE EXT
	D10 -13	U80 + 98		Z SIZE EXT
FF15A0	D0 - 4	U77 + 95		V AXIS EXT
	D5 - 9	U79 + 97		H AXIS EXT
	D10-13	U81 + 99		Z AXIS EXT

SCOPE TP-15, TRIM R56 (6) (and 0V at P2-22) FOR ZERO RAMP. During Section 7 TRIM R59 (1) FOR ZERO OFFSET. During Section 7

SCOPE TP-14, TRIM R55 (5) (And 0V at P2-26) FOR ZERO RAMP During Section 7, TRIM R63 (2) FOR ZERO OFFSET. "

SCOPE TP-13, Enable Z Reset, ~~PUT 10 (17) AT FF1000~~, PUT FFF @ FF1006, ADJ R57 (4) FOR ZERO RAMP, "
ADJ R67 (3) 0 OFFSET. During Section 7

Disable Section Vert Reset, load 1FF at FF1020.

~~LOAD 000 @ FF14C0~~, SCOPE TP-15.

~~LOAD 0 @ FF1000~~, 2ND TRACE TO TOP OF J-4, JUMPER REMOVED.

LOAD 0 @ FF14E0, ADJ R79 FOR HI-LOW TRANSITION JUST BELOW RAIL (FIG. 1A).

LOAD FFF @ FF14E0, ADJ R78 FOR HI-LOW TRANS JUST ABOVE RAIL (FIG 1B).

RELOAD 7FF @ FF14E0 + FF14C0.

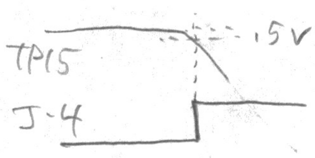


FIG 1A

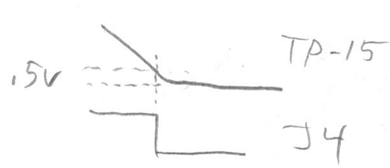


FIG 1B

SAME FOR H RAMP. SET 0 @ FF1500 + FF1520, SCOPE TP-14, ADJUST R80.
SET 1520 TO FFF, ADJUST R81. RELOAD 7FF AT 1500 + FF1520.

SAME FOR Z RAMP. SET 0 @ FF1540 + FF1560, ~~10 @ FF1000.~~ Enable Z ramp
ADJUST R84, LOAD FFF @ FF1560, ADJUST R83

---VERTICAL AXIS LOCATE:
TRIGGER SCOPE ON VERTICAL, SET 4 AT FF1000, ADJUST R16 FOR 0 TO +5
RAMP DURING VERTICAL INTERVAL AT TP-13, 14, 15.

END.

---EXTERNAL AMPLITUDE MULTIPLIER BALANCE---

use L1 with TEST. Set 7FF at these locations:

FF140E, FF142E, FF144E, FF146E, FF148E, FF14AE.
scope triggered to V, observe section 8 and adjust for
AC Null as follows:

Scope	Adjust	Function
R-1 left side	R-60 (7)	V S Ampl.
R17 " "	R-64 (8)	H S Ampl
R33 " "	R-68 (9)	Z S Ampl.
R-14 Right side	R-71 (10)	V A Ampl
R-31 " "	R-72 (11)	H A Ampl
R-47 " "	R-73 (12)	X A Ampl

Initialization Table for: VRG (TEST FILE)

Base = FF1400

	(XS Ampl)		(YS Ampl)		(ZS Ampl)		(XA Ampl)		(YA Ampl)		(ZA Ampl)		(XS Off)		(XA Off)
00	7FF	20	7FF	40	7FF	60	7FF	80	7FF	A0	7FF	C0	0	E0	7FF
02		22		42		62		82		A2		C2	0	E2	
04		24		44		64		84		A4		C4	0	E4	
06		26		46		66		86		A6		C6	0	E6	
08		28		48		68		88		A8		C8	7FF	E8	
0A		2A		4A		6A		8A		AA		CA	0	EA	
0C		2C		4C		6C		8C		AC		CC	7FF	EC	
0E	0	2E	0	4E	0	6E	0	8E	0	AE	0	CE	7F0	EE	0
10	FFF	30	FFF	50	FFF	70	FFF	90	FFF	B0	FFF	D0	FFF	F0	FFF
12	000	32	000	52	000	72	000	92	000	B2	000	D2	000	F2	000
14		34		54		74		94		B4		D4		F4	
16		36		56		76		96		B6		D6		F6	
18		38		58		78		98		B8		D8		F8	
1A		3A		5A		7A		9A		BA		DA		FA	
1C		3C		5C		7C		9C		BC		DC		FC	
1E		3E		5E		7E		9E		BE		DE		FE	

Base = FF1500

	(YS off)		(YA off)		(ZS off)		(ZA off)		(ABR 1)		(ABR 2)				
00	0	20	7FF	40	7FF	60	7FF	80	0	A0	0	C0		E0	NORM
02	0	22		42		62		82		A2		C2		E2	RX=90°
04	0	24		44		64		84		A4		C4		E4	RY=90°
06	0	26		46		66		86		A6		C6		E6	RZ=90°
08	0	28		48		68		88		A8		C8		E8	XS=0
0A	7FF	2A		4A		6A		8A		AA		CA		EA	YS=0
0C	7FF	2C		4C		6C		8C		AC		CC		EC	Para=7FF
0E	7F0	2E	0	4E	0	6E	0	8E	C41	AE	18A4	CE		EE	AB on
10	FFF	30	FFF	50	FFF	70	FFF	90	FFF	B0	FFF	D0		F0	Para=FFF
12	000	32	000	52	000	72	000	92	000	B2	000	D2		F2	Para=0
14		34		54		74		94		B4		D4		F4	
16		36		56		76		96		B6		D6		F6	
18		38		58		78		98		B8		D8		F8	
1A		3A		5A		7A		9A		BA		DA		FA	
1C		3C		5C		7C		9C		BC		DC		FC	
1E		3E		5E		7E		9E		BE		DE		FE	

VRG FIXES

*PROBLEM: LH0062 -15 CONNECTED TO PIN 4 INSTEAD OF PIN 5.

SOLUTION: CUT -15 TO PIN 4, JUMPER TO PIN 5 FOR U-1, 2, 22, 3, 4, 24, 5, 6, 26

---CHANGE ADDRESS MODIFIER AS ON VCB.

---ADD 1K PULLUP U-113 PIN 3 TO +5.

---CHANGE DAC TRIMMERS TO 100K.

---U-86 PIN 3 NOT CONNECTED.

---CHANGE R-21 FROM 68K TO 33K;
R-4 FROM 180L TO 150K;
R-6 + 23 FROM 10K TO 5K;
R-5 + 22 FROM 20K TO 10K.
---CHANGE U-100 + U-102 TO 74LS244.

---U-21 PIN 7 NOT GROUNDED. RUN FROM PIN 8.

*PROBLEM: MAX DATA INVERTED.

SOLUTION: CHANGE U-100, 102 TO 74LS244.

--INVERT BITS 4, 9, 14 TO ANALOG MUXES WITH SPARE IN U-43.

--3 CUTS, 6 JUMPERS AS SHOWN:

```
         ___________                                    ____________
SOLDER   0  U-59    1                             0    U-61   1
 SIDE    |          |                             |           |
         0          2                             0           2
         |          |                             |           |
         0          3     <---ADD                 0           3
         |          |        U-43 12              |           |
         0   |------4-/J\-------------->          0  |--------4
         |   |      |                             |  |        |
         0   |      0                             0  |  |-----5
         |   |      |                             |  |  |     |
         0   |  |---0        X = CUT              0  |  |   /6-/J\------------->
         |   |  |   |                             |  |  |  |  |      <---ADD
         0   |  |   0       /J\ = ADD             0  |  |  |  7         U-43 10
         |   |  |   |            JUMPER           |  |  |  |  |
         0___|__|___0                             0__|__|__|__8
             |  |                                    |  |  |
  CUT--->    X  |                                    |  |  X         <---CUT
             |  |                                    |  |  |
  <------/J\-0  0                                    0  |  \0-/J\------------->
  ADD--->                                               |            <---ADD
  U-43 13                                                               U-43 11
```

```
                                                             <---ADD
         ___________
         0  U-64    0     SOLDER SIDE      0                    TO U-43 8
         |          |                      |            0-/J\-------->
         0          0                      |  0         |
         |          |                      |  |         X    <---CUT
         0          0                      |  |  0      |
         |          |                      |  |  |      @-/J\--------->
         0          0   X = CUT            |  |  |  0   |    <---ADD
         |          |                      |  |  |  |   |       TO U-43 9
         0          0  /J\ = ADD           |  |  |  |   |
         |          |        JUMPER        |  |  |  |   |
         0          0                      |  |  |  |   |
         |          |                         |  |  |   |
         0          0                            |  |
         |          |                               |
         0__________0
```

*PROBLEM: INTENSITY PARAMETERS FROM SIZE, AXIS TO P2 LEFT OFF BOARD.

SOLUTION: ADD 3 WIRES AS SHOWN (**):
---FROM U-22 PIN 8 TO P2 - 18;
---FROM U-24 PIN 8 TO P2 - 34;
---FROM U-26 PIN 8 TP P2 - 36.

SOLDER SIDE, P2 (RIGHT)

```
                         |  | |
                         |  | |   O
                         |  | |    O
           O              \  \ \    O                           //
           |               |  | | O  O  /   /   /   /          //
     O   O | O   O   O   O |  | |  O   /   /   /   /          //
           |              /   | |     /   /   /   /          //
            \   **  **   /   /  |    /   /   /   /  **       O
  __TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__TT__TT
            38  36  34  32  30  28  26  24  22  20  18  16  14  12
```

*PROBLEM: NOISE.

SOLUTION: CHANGE C 1, 4, 5, 7, 9, 12, 13, 15, 17, 18, 19, 20, 21 TO 15pf;

---ADD .1 BYPASS +15 TO U-15, 17, 19;

---RUN #18 INSULATED WIRE FROM P2 PINS 1, 3, 5 TO GROUND PLANE AREA BETWEEN U-15 + U-16.

*PROBLEM: PIN 4 CONNECTED TO -15.

SOLUTION: CHANGE -15 TO PIN 5.

Component List for VRG100 VRG. LS LISTING

Reference No's	Total	Part Name	Part Type	Description
C1, 4-5, 7, 9, 12-13, 15, 17-21	13	~~5F~~ 15pF		No description found in cross ref file
C2, 6, 8, 10, 16, 22, 59-104	52	.1UF		No description found in cross ref file
C3	1	.1TEMP ST		No description found in cross ref file
C11, 14	2	1000P T.S.		No description found in cross ref file
C24, 26, 28, 30-41, 43-58	31	1UF 16V		No description found in cross ref file
CR1-6	6	1N5240		No description found in cross ref file
J1-2, T1-2	4	EJECT-CAL107-1013		No description found in cross ref file
IC7, 20	2	HA4925		No description found in cross ref file
IC18, 36-41	7	AD533JH		No description found in cross ref file
IC43	1	7404		No description found in cross ref file
IC56-63	2D8	8599		No description found in cross ref file
IC76-81, 94-99	12	HI506		No description found in cross ref file
R1-3, 6-7, 10-11, 13-15, 17-19, 23-24, 27-28, 30-36, 39, 42-44, 46-48, 51-52, 82-84 R83-94? NO	36	10K		No description found in cross ref file
R4	1	180K		No description found in cross ref file
R5, 9, 22, 26, 37-38, 41, 49-50, 53-54, 85-86	13	20K		No description found in cross ref file
R8, 25, 40	3	1K		No description found in cross ref file
R12, 29, 45	3	200 OHM		No description found in cross ref file
R21	1	68K		No description found in cross ref file
R58, 61-62, 65-66, 69-70, 74-77, 88	12	2.2M		No description found in cross ref file
R87, 89	2	2.2K		No description found in cross ref file
RP1	1	SIP 8X2.2K		No description found in cross ref file
RV16, 78-81, 83-84	7	BOURNS 3299 10K		No description found in cross ref file

Reference No's	Total	Part Name	Part Type	Description
RV55-57,59-60,63-64, 67-68,71-73	12	BOURNS 3006 20K		No description found in cross ref file
SU1-12	12	SOCKETS-28		No description found in cross ref file
SU13-25	13	SOCKETS-24		No description found in cross ref file
SU26-34	9	SOCKETS-20		No description found in cross ref file
SU35-57	23	SOCKETS-14		No description found in cross ref file
SU58-65	8	SOCKETS-10		No description found in cross ref file
SU66-69	4	SOCKETS-8		No description found in cross ref file
SU70-120	51	SOCKETS-16		No description found in cross ref file
TP1-15	15	TEST POINTS		No description found in cross ref file
U1-6,22,24,26	9	LH0062		No description found in cross ref file
U7	1	~~HA2549~~ HA4925		No description found in cross ref file
U14,16,23,25,27	5	AH0134		No description found in cross ref file
U15,17,19	3	HA2535		No description found in cross ref file
UX1	1	7433	IC	QUAD 2-INPUT NOR BUFFERS W/OC OUTPUTS

AD533JH

74LS138 ✓
74LS 244 ✓
260 ✓
25LS 2521 ✓
74$ 74 ✓
240

need	VRG	not on Parts list
7*4	AD533JH	
1	74LS04	— incorrect 7404
20*4	DM8579	— INCORRECT AMOUNT
12*4	DAC-80-CBIV	LEFT OFF
2*4	74S74	LEFT OFF
4	7402	LEFT OFF
4	74S38	LEFT OFF
4	74LS260	LEFT OFF
2*4	25LS2521	LEFT OFF
2*4	74LS240	LEFT OFF
2*4	74LS138	LEFT OFF
4	25LS157	LEFT OFF
4*4	74LS244	LEFT OFF

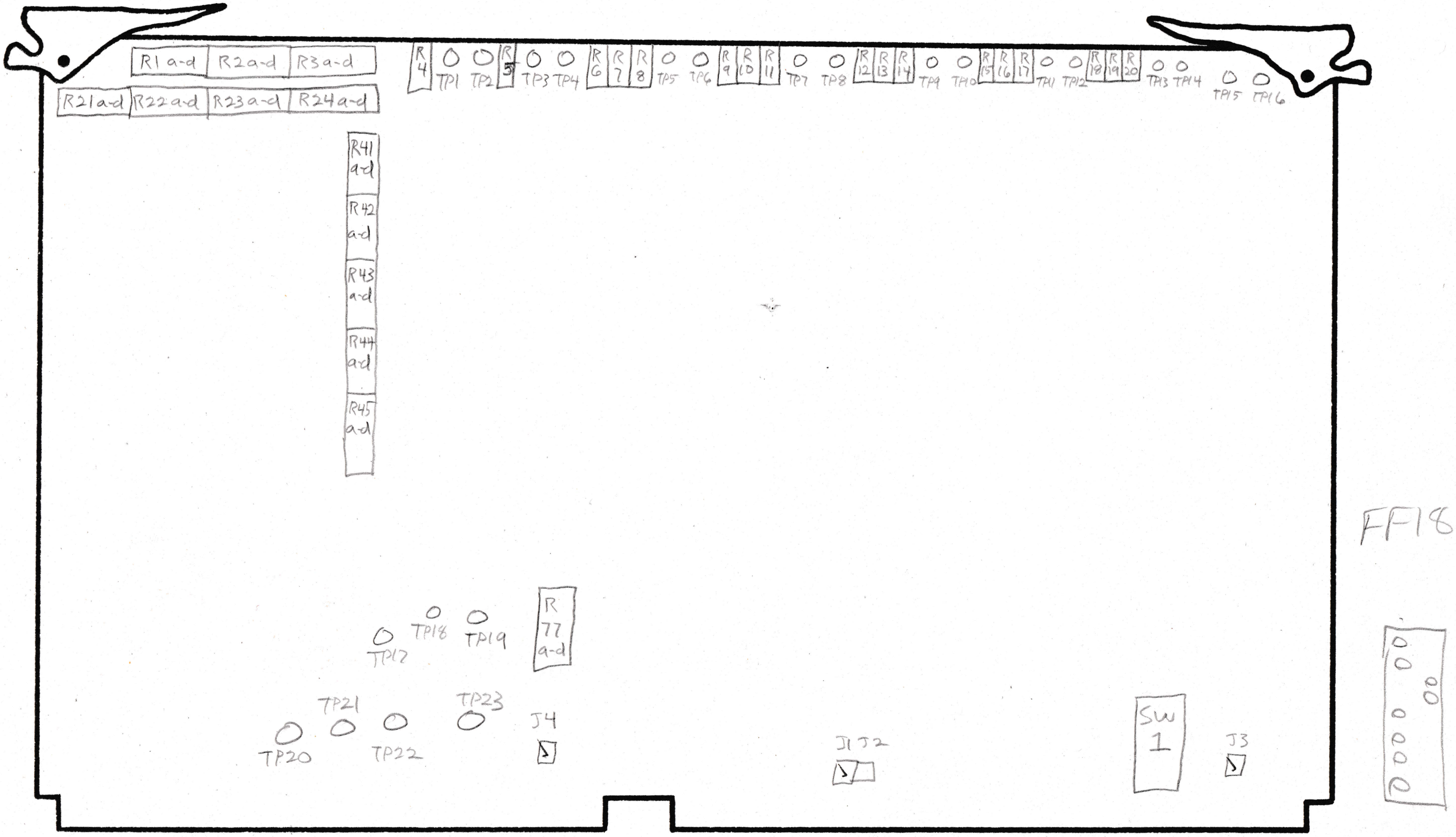
PROGRAM NAME VRG VOL.# VRG CATEGORY

25LS157	1
25LS2521	2
7402	1
7433	1
74LS04	1
74LS138	2
74LS240	2
74LS244	4
74LS260	1
74S38	1
74S74	2
AD533JH	7
AH0134	5
DAC 80 CBI V	12
DM8599	20
HA2535	3
HA4925	2
HI506	12
LH0062	9

AKG

BOARD VRM-100A VER.

+15 400ma
-15 600ma



FF1800

1 119 1 139

P2 P1

Current

+15v 411ma
-15v 554ma

$$\begin{array}{r} 517 \\ -106 \\ \hline 411 \end{array} \qquad \begin{array}{r} 880 \\ -226 \\ \hline 554 \end{array}$$

VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17		18	
19	X/X @	20	X IN (H RASTER) @
21	X/Y @	22	
23		24	Y IN (V RASTER) @
25	Y/X @	26	
27	Y/Y @	28	Z IN (Z RASTER) @
29		30	Y/Z @
31	Z/X @	32	Z REF @
33	Z/Y @	34	ZP/Z @
35		36	X/Z @
37		38	TZ @
39		40	ZP/Y @
41		42	TY @
43		44	ZP/X @
45		46	TX @
47		48	
49		50	
51	X out	52	
53		54	
55	Y out	56	
57		58	
59	Z out	60	
61		62	X/Z MSB
63	P out	64	Y/Z MSB
65		66	
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane. ALL other pins are.

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

PLACE VRM ON EXTENDER. VTB + VRG MUST BE PRESENT.

SET 7FF AT EACH LOCATION, ZERO EACH DAC ACCORDING TO CHART:

ADDRESS	SCOPE	DAC#	MATRIX	
FF1800	TP-1	0	A	
FF1820	TP-2	1	D	
FF1840	TP-4	2	G	
FF1860	TP-3	3	TX	
FF1880	TP-6	4	B	
FF18A0	TP-5	5	E	
FF18C0	TP-8	6	H	
FF18E0	TP-7	7	TY	
FF1900	TP-16	8	C	
FF1920	TP-15	9	F	
FF1940	TP-13	10	I	
FF1960	TP-14	11	TZ	
FF1980	TP-11	12	PX	
FF19A0	TP-12	13	PY	AUX ROTATION
FF19C0	TP-9	14	PZ	(LESS BANDWIDTH)
FF19E0	TP-10	15	SA	

X	A	B	C	PX
Y	D	E	F	PY
Z	G	H	I	PZ
	TX	TY	TZ	SA
	X	Y	Z	

SET RASTER GEN X, Y, Z SIZES TO MAXIMUM, Z RAMP ON (FF14C0, FF1500, FF1540=0, FF1000=10).

SCOPE TP-21, ADJUST R22B, R3B, AND R43B FOR AC NULL.
SET R22C, R3C, R43C FOR ZERO DC OFFSET.

SCOPE TP-20, ADJUST R42B, 21B, 2B FOR AC NULL.
SET R42C, R21C, R2C FOR ZERO DC OFFSET.
TURN R3 ALL THE WAY CCW.

SCOPE TP-22, ADJUST R24B, 23B, R1B FOR AC NULL.
SET R24C, R23C, R1C FOR ZERO DC OFFSET.
SET FF1540 TO 7FF, FF1000 TO C4.

SCOPE TP-13, VERIFY 0V AT TP-13 ON VRG.
TURN R3 CW TO SET OFFSET APPROX. ~~-2.23V.~~ 1.4V
THIS WILL BE FURTHER ALIGNED IN VCR SETUP.

SCOPE TP-23, ADJUST R45B, 44B, 41B FOR AC NULL.
SET R45C, 44C, 41C FOR ZERO DC OFFSET.

SCOPE TOP OF J4 AND TP-21.

```
        (ON  REV A BOARDS, PLACE A 3.3K   RESISTOR BETWEEN TOP OF J4 AND +5).
        SET FF1800=0, FF1520=FFF.
        ADJUST R77A SO THAT J4 TOP GOES LOW JUST BEFORE TP-21 SIGNAL HITS
            + RAIL.
        SET FF1520=0, SET R77A SO THAT J4 TOP GOES LOW JUST BEFORE RAMP HITS
            - RAIL.
        SET FF1800=7FF, FF1880=0, FF1520=FFF.

SCOPE TP-20 AND TOP J4.
        ADJUST R77C SO THAT J4 SIGNAL GOES LOW JUST BEFORE RAMP HITS + RAIL.
        SET FF1520=0, ADJUST R77D FOR LOW TRANSITION AT J4 JUST BEFORE RAMP
            HITS - RAIL.

END.
```

Initialization Table for: VRM (TEST FILE) L1

L242-248

Base = FF18ØØ

Addr	(A)	Addr	(D)	Addr	(G)	Addr	(Tx)	Addr	(B)	Addr	(E)	Addr	(H)	Addr	(Ty)
00	0	20	7FF	40	7FF	60	7FF	80	7FF	A0	0	C0	7FF	E0	7FF
02	0	22	7FF	42	7FF	62	7FF	82	7FF	A2	7FF	C2	0	E2	7FF
04	7FF	24	7FF	44	0	64	7FF	84	7FF	A4	0	C4	7FF	E4	7FF
06	7FF	26	0	46	7FF	66	7FF	86	0	A6	7FF	C6	7FF	E6	7FF
08	0	28	7FF	48	7FF	68	7FF	88	7FF	A8	0	C8	7FF	E8	7FF
0A	0	2A	7FF	4A	7FF	6A	7FF	8A	7FF	AA	0	CA	7FF	EA	7FF
0C	7FF	2C	7FF	4C	7FF	6C	7FF	8C	7FF	AC	7FF	CC	7FF	EC	7FF
0E	0	2E	7FF	4E	7FF	6E	7FF	8E	7FF	AE	0	CE	7FF	EE	7FF
10	FFF	30	FFF	50	FFF	70	FFF	90	FFF	B0	FFF	D0	FFF	F0	FFF
12	000	32	0	52	0	72	0	92	0	B2	0	D2	0	F2	0
14		34		54		74		94		B4		D4		F4	
16		36		56		76		96		B6		D6		F6	
18		38		58		78		98		B8		D8		F8	
1A		3A		5A		7A		9A		BA		DA		FA	
1C		3C		5C		7C		9C		BC		DC		FC	
1E		3E		5E		7E		9E		BE		DE		FE	

L249 L250 L252 L263 L267

Base = FF19ØØ

Addr	(C)	Addr	(F) A	Addr	(I) A	Addr	(Tz) TY	Addr	(Px) TY+1	Addr	(Py) PX	Addr	(Pz) PX	Addr	(SA) TZ
00	7FF	20	7FF	40	0	60	7FF	80	7FF	A0	7FF	C0	7FF	E0	7FF
02	7FF	22	0	42	7FF	62	7FF	82	7FF	A2	7FF	C2	7FF	E2	7FF
04	0	24	7FF	44	7FF	64	7FF	84	7FF	A4	7FF	C4	7FF	E4	7FF
06	7FF	26	7FF	46	0	66	7FF	86	7FF	A6	7FF	C6	7FF	E6	7FF
08	7FF	28	7FF	48	0	68	7FF	88	7FF	A8	7FF	C8	7FF	E8	7FF
0A	7FF	2A	7FF	4A	0	6A	7FF	8A	7FF	AA	7FF	CA	7FF	EA	7FF
0C	7FF	2C	7FF	4C	7FF	6C	7FF	8C	7FF	AC	7FF	CC	7FF	EC	7FF
0E	7FF	2E	7FF	4E	0	6E	7FF	8E	0	AE	0	CE	0	EE	7FF
10	FFF	30	FFF	50	FFF	70	FFF	90	FFF	B0	FFF	D0	FFF	F0	FFF
12	0	32	0	52	0	72	0	92	0	B2	0	D2	0	F2	0
14		34		54		74		94		B4		D4		F4	
16		36		56		76		96		B6		D6		F6	
18		38		58		78		98		B8		D8		F8	
1A		3A		5A		7A		9A		BA		DA		FA	
1C		3C		5C		7C		9C		BC		DC		FC	
1E		3E		5E		7E		9E		BE		DE		FE	

L385 L395 L387 L398

VRM   FIXES

*PROBLEM: U-87 PINS 4 AND 6 SWAPPED.

SOLUTION: CUT AND JUMPER AS SHOWN:

```
          COMP SIDE               |              SOLDER SIDE
                                  |
 _________          ___________   |    ___________         ___________
|    V   |         |    V     |   |    0         1         0         1
|        |____/----|          |   |    |   U-87  |         |   U-86  |
|  U-86  |         |   U-87   |   |    0         2         0         2
|        |         |          |   |    |         |         |         |
|        |____/----|          |   |    0         3         0         3
|        |         |          |   |    |         |         |         |
|        |         |          |   |    0   |-----4         0  J     /4
|        |____/----|          |   |    |   |     |  /--------/ \---/ |  <--ADD
|        |         |          |   |    0   /     0 /       0         0
|        |         |          |   |    |  J <-ADD|/        |         |
|        |____/-X--|  <---CUT |   |    0   \     0=====|   0         0
|        |         |          |   |    |   |     |   ||    |         |
|        |         |          |   |    0   |     0   XX    0         0
|        |____/----|          |   |    |   |----\|   ||    |         |
|________|         |__________|   |    0________\0=====|   0_________0
                                  |                <---CUT
                                  |
                      J           |
        X = CUT      / \ = ADD  JUMPER
```

*PROBLEM: U-59 PIN 2 GROUND NOT CONNECTED.

SOLUTION: CONNECT:

```
                                            \\
                                             \\
                             __________       ||
         SOLDER SIDE         0         1      ||
                             |  U-59   |  J   ||
                             0         2-/ \--||    <---ADD
                             |         |      ||
          J                  0         0      ||
         / \ = ADD           |         |       \\
              JUMPER         0         0        \\
                             |         |
                             0         0
                             |         |
                             0         0
```

*PROBLEM: VALUE CHANGES.

SOLUTION: CHANGE R68, 61, 53, 76 FROM 100K ohms TO 100 ohms.
--CHANGE R80, 81 FROM 10K ohms TO 6.8K ohms.

*PROBLEM: NOISE.

SOLUTION: JUMPER BETWEEN P1 PIN 3 AND GROUND PLANE AREA ABOVE P2 - 119.

User 1103

VRM101A.DC

		DAC	
FF1800	TP1	0	A
1820	TP2	1	D
40	TP4	2	G
60	TP3	3	TX
80	TP6	4	B
A0	TP5	5	E
C0	TP8	6	H
E0	TP7	7	TY
900	TP-16	8	C
20	TP-15	9	F
40	TP-13	10	I
60	TP-14	11	TZ
80	TP11	12	P_X
A0	TP12	13	P_Y
C0	TP9	14	P_Z
E0	TP10	15	S_A

Aux Rotation (less bandwidth)

X	A	B	C	P_X
Y	D	E	F	P_Y
Z	G	H	I	P_Z
	T_X	T_Y	T_Z	S_A
	X	Y	Z	

Address	SCOPE	DAC#	Matrix
FF1800	TP-1	0	A
FF1820	TP-2	1	D
FF1840	TP-4	2	C
FF1860	TP-3	3	TX
FF1880	TP-6	4	B
FF18A0	TP-5	5	E
FF18C0	TP-8	6	H
FF18E0	TP-7	7	TY
FF1900	TP-16	8	C
FF1920	TP-15	9	F
FF1940	TP-13	10	I
FF1960	TP-14	11	TZ
FF1980	TP-11	12	PX
FF19A0	TP-12	13	PY
FF19C0	TP-9	14	PZ
FF19E0	TP-10	15	SA

AUX ROTATION
(LESS BANDWIDTH)

X	A	B	C	PX
Y	D	E	F	PY
Z	G	H	I	PZ
	TX	TY	TZ	SA
	X	Y	Z	

Place VRM on extender. VTB+URG must be present.
Set 7FF at each location, zero each DAC according to chart.
Set Raster Gen X, Y, Z sizes to maximum, Z Ramp on
(FF14C0, FF1500, FF1540 = 0, FF1000 = 10)
Scope TP 21, Adjust R22B, R3B, and R43B for AC Null.
Set R22C, R3C, R43C for zero DC offset
Scope TP20, Adjust R42B, 21B, 2B for AC Null,
Set R42C, R21C, R2C for zero DC offset
Scope TP22, Adjust R24B, 23B, R1B for AC Null,
Set R24C, R23C, R1C for zero DC offset.
Turn R3 CW to set offset approx -2.23V.
This will be further aligned in VCR setup.
Scope TP23, Adjust R45B, 44B, 41-B, for AC Null,
Set R45C, 44C, 41C for zero DC offset.
Scope Top of J4 and TP21 (over)

Turn R3 all the way CCW.

Set FF1540 to 7FF, FF1000 to C4
scope TP13, verify 0V at TP13 on VRG

(on Rev A boards, place a 3.3kΩ resistor between top of J4 and +5.)

Set FF1800=0, FF1520=FFF

Adjust R77A so that J4 top goes low just before TP21 signal hits + Rail.

Set FF1520=0, set R77A so that J4 top goes low just before ramp hits − rail.

Set FF1800=7FF, FF1880=0, FF1520=FFF.

Scope TP20 and Top J4, adjust R77-C so that J4 signal goes low just before ramp hits the + rail.

Set FF1520=0, adjust R77-D for low transition at J4 just before ramp hits negative rail.

END

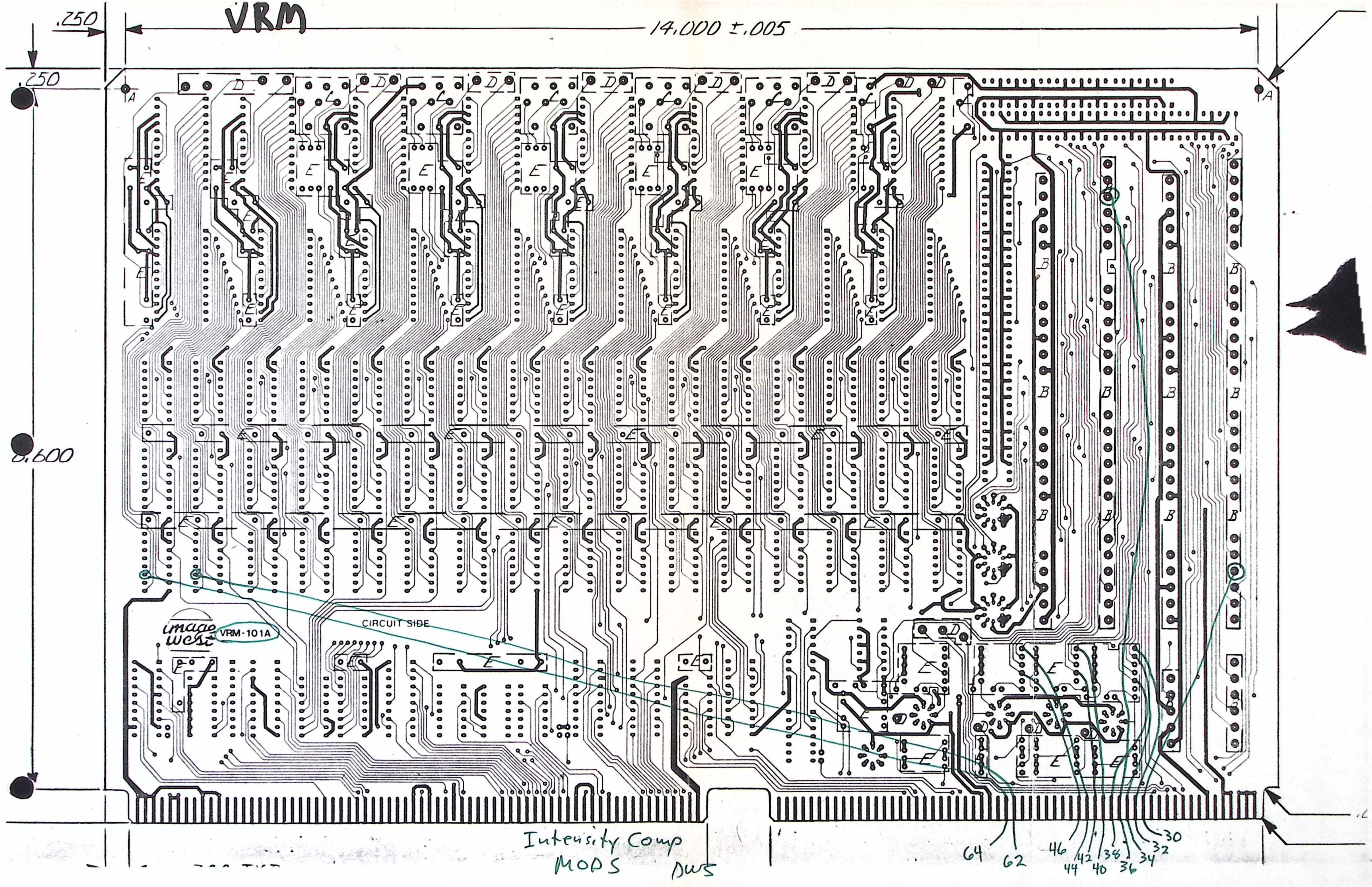
VRM 101A Additions for Intensity comp:

R46 to P2-32 (ZREF)
R47 to P2-34 (ZP/Z)
U-56 Y to P2-30 (Y/Z)
U-10 Y to P2 36 (X/Z)
R 54 to P2 40 (ZP/Y)
R57 to P2 42 (TY)
R50 to P2-38 (TZ)
R 62 to P2-44 (ZP/X)
R65 to P2-46 (TX)

U73-11 to P2-62 (X/Z MSB)
U-74-11 to P2-64 (Y/Z MSB)

(Note- add 3,3k pullup from J4 top to +5)

(added to VRM101A.DC)
5/12


VRM
.250
14.000 ±.005
.250
8.600
CIRCUIT SIDE
image west
VRM-101A
Intensity Comp
MODS
DWS
64
62
46
44
42
40
38
36
34
32
30

VRM

Reference No's	Total	Part Name	Part Type	Description
C1-48	48	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C49-80,89-95	39	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C81-88	8	C 15PF	No description found in cross ref file	
CR1-8	8	1N5240B	DIODE	10V ZENER DIODE
E1-2	2	EJECTOR	HARDWARE	CALMARK 107-1013 EJECTOR
R25-40	16	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R46,47-50,55-58,51-52,54,59-60, 62-67,69-75,~~80-81~~	21	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R53,61,68,76	4	R ~~100K~~ 100Ω OHM 1/4W 2%	No description found in cross ref file	
R78-79	2	R 2K OHM 1/4W 2%	RESISTOR	2K OHM 1/4W 2% RESISTOR
R82	1	R 3.3K OHM 1/4W 2%	No description found in cross ref file	
R80-81	2	R 6.8K OHM		
RP1	1	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
RS1-3	2 3	RND SOCKET-10 ST	SOCKET	10 PIN SOLDER TAIL ROUND SOCKET
RS4-8	5	RND SOCKET-8 ST	SOCKET	8 PIN SOLDER TAIL ROUND SOCKET
RV1-3,21-24,41-45, 77	13	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
RV4-20	17	RV 20K BOURNS 3006	POT	20K 3006 10 TURN PC POT
SU1-67	67	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU68-76	9	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SU77-83	7	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU84-88	5	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SW1	1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
TP1-23	23	TEST-POINT STUD	HARDWARE	BOARD STUD TEST POINT
U1-8,11-18	16	DAC-80	IC	12 BIT DAC WITH OP AMP
U9-10,19-20,37-38, 56-57,76	9	429B	IC	FAST ANALOG MULTIPLIER
U21-36,40-55,59-74	48	DM8599 - 74189	IC	16X4 RAM
U39,58,75	3	AD533JH	IC	ANALOG MULTIPLIER

Reference No's	Total	Part Name	Part Type	Description
U77	1	HA4925	IC	QUAD COMPARATOR
U78,85	2	74LS240	IC	OCTAL BUS DRIVER
U79	1	74LS157	IC	QUAD 2-1 DATA MULTIPLEXER
U80-81	2	74LS244	IC	OCTAL BUS DRIVER
U82	1	74LS260	IC	DUAL 5-INPUT NOR GATE
U83	1	74S74	IC	DUAL D FLIP-FLOP
U84	1	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U86-87	2	74LS138	IC	3-TO-8 LINE DECODER
U88-89	2	25LS2521	IC	8 BIT COMPARATOR
U90-93	4	HA2535	IC	FAST FET OP-AMP
U94	1	AD584	No description found in cross ref file	
U95	1	7433	IC	QUAD 2-INPUT NOR BUFFERS W/OC OUTPUTS

VRM

Reference No's	Part Name	Part Type	Description
C1-48	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C49-80	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C81-88	C 15PF	No description found in cross ref file	
C89-95	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
CR1-8	1N5240B	DIODE	10V ZENER DIODE
E1-2	EJECTOR	HARDWARE	CALMARK 107-1013 EJECTOR
R1	Reference not found in component list		
R2	Reference not found in component list		
R3	Reference not found in component list		
R4	Reference not found in component list		
R5	Reference not found in component list		
R6	Reference not found in component list		
R7	Reference not found in component list		
R8	Reference not found in component list		
R9	Reference not found in component list		
R10	Reference not found in component list		
R11	Reference not found in component list		
R12	Reference not found in component list		
R13	Reference not found in component list		
R14	Reference not found in component list		
R15	Reference not found in component list		
R16	Reference not found in component list		
R17	Reference not found in component list		
R18	Reference not found in component list		
R19	Reference not found in component list		
R20	Reference not found in component list		
R21	Reference not found in component list		
R22	Reference not found in component list		
R23	Reference not found in component list		
R24	Reference not found in component list		
R25-40	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R41	Reference not found in component list		
R42	Reference not found in component list		
R43	Reference not found in component list		
R44	Reference not found in component list		
R45	Reference not found in component list		
R46	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R47	Reference not found in component list		
R48	Reference not found in component list		
R49	Reference not found in component list		
R50	Reference not found in component list		
R51-52	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R53	R 100K OHM 1/4W 2%	No description found in cross ref file	
R54	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R55	Reference not found in component list		
R56	Reference not found in component list		
R57	Reference not found in component list		

Reference No's	Part Name	Part Type	Description
R58	Reference not found in component list		
R59-60	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R61	R 100K OHM 1/4W 2%	No description found in cross ref file	
R62-67	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R68	R 100K OHM 1/4W 2%	No description found in cross ref file	
R69-75	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R76	R 100K OHM 1/4W 2%	No description found in cross ref file	
R77	Reference not found in component list		
R78-79	R 2K OHM 1/4W 2%	RESISTOR	2K OHM 1/4W 2% RESISTOR
R80-81	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R82	R 3.3K OHM 1/4W 2%	No description found in cross ref file	
RP1	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
RS1-3	RND SOCKET-10 ST	SOCKET	10 PIN SOLDER TAIL ROUND SOCKET
RS4-8	RND SOCKET-8 ST	SOCKET	8 PIN SOLDER TAIL ROUND SOCKET
RV1-3	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
RV4-20	RV 20K BOURNS 3006	POT	20K 3006 10 TURN PC POT
RV21-24	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
RV25	Reference not found in component list		
RV26	Reference not found in component list		
RV27	Reference not found in component list		
RV28	Reference not found in component list		
RV29	Reference not found in component list		
RV30	Reference not found in component list		
RV31	Reference not found in component list		
RV32	Reference not found in component list		
RV33	Reference not found in component list		
RV34	Reference not found in component list		
RV35	Reference not found in component list		
RV36	Reference not found in component list		
RV37	Reference not found in component list		
RV38	Reference not found in component list		
RV39	Reference not found in component list		
RV40	Reference not found in component list		
RV41-45	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
RV46	Reference not found in component list		
RV47	Reference not found in component list		
RV48	Reference not found in component list		
RV49	Reference not found in component list		
RV50	Reference not found in component list		
RV51	Reference not found in component list		
RV52	Reference not found in component list		
RV53	Reference not found in component list		
RV54	Reference not found in component list		
RV55	Reference not found in component list		
RV56	Reference not found in component list		
RV57	Reference not found in component list		
RV58	Reference not found in component list		

Reference No's	Part Name	Part Type	Description
RV59	Reference not found in component list		
RV60	Reference not found in component list		
RV61	Reference not found in component list		
RV62	Reference not found in component list		
RV63	Reference not found in component list		
RV64	Reference not found in component list		
RV65	Reference not found in component list		
RV66	Reference not found in component list		
RV67	Reference not found in component list		
RV68	Reference not found in component list		
RV69	Reference not found in component list		
RV70	Reference not found in component list		
RV71	Reference not found in component list		
RV72	Reference not found in component list		
RV73	Reference not found in component list		
RV74	Reference not found in component list		
RV75	Reference not found in component list		
RV76	Reference not found in component list		
RV77	RV MFT 7104D-419-103 POT		BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
SU1-67	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU68-76	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SU77-83	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU84-88	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SW1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
TP1-23	TEST-POINT STUD	HARDWARE	BOARD STUD TEST POINT
U1-8	DAC-80	IC	12 BIT DAC WITH OP AMP
U9-10	429B	IC	FAST ANALOG MULTIPLIER
U11-18	DAC-80	IC	12 BIT DAC WITH OP AMP
U19-20	429B	IC	FAST ANALOG MULTIPLIER
U21-36	DM8599	IC	16X4 RAM
U37-38	429B	IC	FAST ANALOG MULTIPLIER
U39	AD533JH	IC	ANALOG MULTIPLIER
U40-55	DM8599	IC	16X4 RAM
U56-57	429B	IC	FAST ANALOG MULTIPLIER
U58	AD533JH	IC	ANALOG MULTIPLIER
U59-74	DM8599	IC	16X4 RAM
U75	AD533JH	IC	ANALOG MULTIPLIER
U76	429B	IC	FAST ANALOG MULTIPLIER
U77	HA4925	IC	QUAD COMPARATOR
U78	74LS240	IC	OCTAL BUS DRIVER
U79	74LS157	IC	QUAD 2-1 DATA MULTIPLEXER
U80-81	74LS244	IC	OCTAL BUS DRIVER
U82	74LS260	IC	DUAL 5-INPUT NOR GATE
U83	74S74	IC	DUAL D FLIP-FLOP
U84	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT

Reference No's	Part Name	Part Type	Description
U85	74LS240	IC	OCTAL BUS DRIVER
U86-87	74LS138	IC	3-TO-8 LINE DECODER
U88-89	25LS2521	IC	8 BIT COMPARATOR
U90-93	HA2535	IC	FAST FET OP-AMP
U94	AD584	No description found in cross ref file	
U95	7433	IC	QUAD 2-INPUT NOR BUFFERS W/OC OUTPUTS

BOARD VCR-100A

VER.

+15 - 300ma
-15 - 600ma

RESCAN CHANNEL: ALL PARAMETERS CAN EFFECT AS MANY AS SIXTEEN RASTER SEGMENTS OF VARIABLE LENGTH AT A TIME.

FLYING SPOT CHANNEL: ALL PARAMETERS EFFECT THE ENTIRE RASTER. NO SEGMENTING IS AVAILABLE.

	OFFSET	AMPLITUDE	CONNECTION
HORIZONTAL POSITION	0 - 4095	0 - 4095	0 - 31
VERTICAL POSITION	0 - 4095	0 - 4095	0 - 31
INTENSITY	0 - 4095	0 - 4095	0 - 31
BLANKING FIXED TO SCREEN			
+ X EDGE	0 - 4095		
- X EDGE	0 - 4095		
+ Y EDGE	0 - 4095		
- Y EDGE	0 - 4095		
+ Z EDGE	0 - 4095		
- Z EDGE	0 - 4095		

16 bits x16

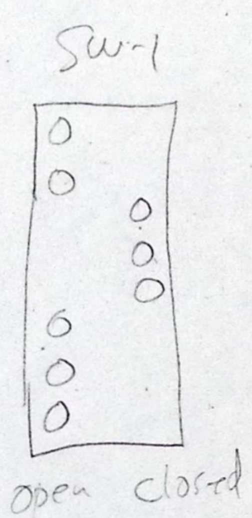
BITS	
0-4	V-POS
5-9	H-POS
10-14	INTENSITY

ADDRESSING

BITS
1-4 1 of 16 Segments
5-8 1 of 13 addresses

	8 7 6 5			DAC	
FF1C00	0000	V POS AMPLITUDE		0	
20	0001	H POS AMPLITUDE		1	
46	0010	INTENSITY AMPLITUDE		2	
60	0011	V POS OFFSET		3	
80	0100	H POS OFFSET		4	
A0	0101	INTENSITY OFFSET		5	
C0	0110	V ?EDGE BLANKING	000	6	
E0	0111	V ?EDGE BLANKING	FFF	7	
FF1D00	1000	H ?EDGE BLANKING	000	8	
20	1001	H ?EDGE BLANKING	FFF	9	
40	1010	Z ?EDGE BLANKING	000	10	Front
60	1011	Z ?EDGE BLANKING	FFF	11	Rear
80	1100	CONNECTION REGISTER			

FF1C00



DTACK TURNED AROUND IN 125 N SEC

0 0/1/1/0 1 0 1/1 0 1 0/1 1 0 1
3 5 A D

VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17	AB1	18	
19	AB2	20	
21	AB3	22	INTENSITY OUT @
23	AB4	24	
25	AB5	26	VERT POS AMPL. @
27	AB6	28	
29	AB7	30	HOR POS AMPL @
31	AB8	32	
33	AB9	34	
35	AB10	36	
37	AB11	38	AB17
39	AB12	40	AB18
41	AB13	42	AB19
43	AB14	44	AB20
45	AB15	46	AB21
47	AB16	48	AB22
49		50	AB23
51	VERT IN @	52	AB24
53		54	AB25
55	HOR IN @	56	AB26
57		58	AB27
59	Z IN @	60	AB28
61		62	AB29
63		64	AB30
65		66	AB31
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane. ALL other pins are.

AB1 - AB31 ANALOG BUS LINES

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

ANALOG BUS

#	P-2#	DESCRIPTION	REMARKS	
0	n/a	GND (off)	TO MINIMIZE CROSSTALK	
1	17	DSP (sin)	BOARD #1	UNIQUE TO A SLAVE CHANNEL
2	19	DSP (cos)		
3	21	HFO		
4	23	HFO		
5	25	DSP (sin)	BOARD #2	
6	27	DSP (cos)		
7	29	HFO		
8	31	HFO		
9	33	DSP (sin)	BOARD #3	
10	35	DSP (cos)		
11	37	HFO		
12	39	HFO		
13	41	VERT RAMP	FROM VTB	
14	43	HORIZ. RAMP	FROM VTB	
15	45	Z RAMP	FROM VTB	
16	47	CHANNEL SPARE		
17	38	DSP (sin)	BOARD #1*	SHARED BY ALL CHANNELS
18	40	DSP (cos)		
19	42	HFO		
20	44	HFO		
21	46	DSP (sin)	BOARD #2*	
22	48	DSP (cos)		
23	50	HFO		
24	52	HFO		
25	54	EXT IN #1	REAR PANEL	
26	56	EXT IN #2	REAR PANEL	
27	58	EXT IN #3	REAR PANEL	
28	60	VID IN #1	FROM ROUTING	
29	62	VID IN #2	FROM ROUTING	
30	64	VID IN #3	FROM ROUTING	
31	66	VID IN #4	FROM ROUTING	

DSP = DIGITAL SLAVED PAIR OSCILLATOR
HFO = HIGH FREQUENCY OSCILLATOR

* BOARDS TO BE LOCATED IN MASTER CHASSIS

VCR SETUP
(REQUIRES VTB, VRG, VRM IN RESCAN CHASSIS & TEST CRT)

-SET VTB AS FOLLOWS:

ADDRESS	DATA	
FF1000	C4	
FF1004	1	
FF1006	FFF	
FF1020	1FF	

-SET VRG AS FOLLOWS:

FF1400	7FF	
FF1420	7FF	
FF1440	7FF	
FF1460	7FF	
FF1480	7FF	
FF14A0	7FF	
FF14C0	0	X
FF14E0	7FF	
FF1500	0	Y
FF1520	7FF	
FF1540	7FF	
FF1560	7FF	
FF1580	0	
FF15A0	0	

-SET VRM AS FOLLOWS:

FF1800	0
FF1820	7FF
FF1840	7FF
FF1860	7FF
FF1880	7FF
FF18A0	0
FF18C0	7FF
FF18E0	7FF
FF1900	7FF
FF1920	7FF
FF1940	0
FF1960	7FF
FF1980	7FF
FF19A0	7FF
FF19C0	7FF
FF19E0	7FF

-SET VCR AS FOLLOWS:

FF1C00	7FF
FF1C20	7FF
FF1C40	7FF

```
        FF1C60    7FF
        FF1C80    7FF
        FF1CA0    7FF
        FF1CC0    7FF
        FF1CE0    7FF
        FF1D00    7FF
        FF1D20    7FF
        FF1D40    7FF
        FF1D60    7FF
        FF1D80      0

VID:    FF2000      0
        FF2002      0
        FF2004      0
        FF2006      0
        FF2008      0
        FF200A      0
        FF200C      0
        FF200E      0
        FF2010      0
        FF2012    7FF
        FF2018      4

        (TZ  = FF1960)
        (V/Z = FF1920)
        (H/Z = FF1900)
```

Load Test, L1,
set 7FF at:
FF1CCE
FF1CEE
FF1D0E
FF1D2E
FF1D4E
FF1D6E
FF1C0E
FF1C2E
FF1C4E

ZERO DAC'S AS FOLLOWS (FOR ZERO VOLTS During Seg 8):

ADJUST	SCOPE	DAC#		
R6	TP-9	7	FF1CE0	-VB
R9	TP-10 *	9	FF1D20	-HB
R12	TP-11	11	FF1D60	-2B
R4	TP-12	10	FF1D40	+2B
R2	TP-13 *	8	FF1D00	+HB
R3	TP-14	6	FF1CC0	+VB
R7	TP-15	0	FF1C00	VPA
R10	TP-16	1	FF1C20	HPA
R13	TP-17	2	FF1C40	IA
R15	TP-18	3	FF1C60	VPO
R16	TP-19	4	FF1C80	HPO
R17	TP-20	5	FF1CA0	IO

Insert "Ext Bus Mult, Bal" and "Blkg Window check"

VCR PERSPECTIVE DIVIDER SETUP:

---- VCR ON EXTENDER.
---- NORMAL INITIALIZATION.
---- VERIFY 0V AT TP-13 ON VRG (IT CAN BE REACHED WITHOUT AN EXTENDER ON VRG).
---- ~~PUT FFF @ FF1920~~.
---- TURN R73 ALL THE WAY CW THEN BACK 2 TURNS.
---- PUT SCOPE IN XY, X PROBE TO ~~BOTTOM OF J5~~ TP-21, Y TO ~~BOTTOM OF J4~~ TP-2.
GROUND INPUT AMPS ON SCOPE, PUT DOT IN LOWER RIGHT CORNER.

- Set FF1960=0

--- UNGROUND INPUTS, SET TO 1V/CM, ADJ R74 ~~R20-D~~ FOR LEFT SIDE OF TRACE TO BE ~~APPROX~~. 0VDC. / Set FF1960=7FF

--- ADJUST R73 FOR DOT TO SIT AT ~~CURVE TO CROSS~~ A POINT 1.4 VOLTS UP AND 1.4 VOLTS OVER FROM ZERO. (EXPAND SENSITIVITY IF NECESSARY)

~~--- AXIS DOT SHOULD BE NEAR THIS POINT.~~

--- RE-ADJUST R74 ~~R20-D~~ FOR ZERO, AND R73 AS ABOVE.

~~--- SET 7FF TO FF1920. VERIFY 7FF @ FF1960.~~

--- TRIM R3 ON VRM ~~IF NECESSARY FOR DOT TO SIT AT 1.4 V. UP AND 1.4 V. OVER FROM ZERO~~. to move Dot's X position, R73 for Y position. R73 and 74 interact; you may need to retrim R74 (with Ø at FF1960)

EXT BUS MULTIPLIER BALANCES:

--- ~~LOAD 35AD AT FF1D00~~, SCOPE TP-3.
OFFSET R59-B SLIGHTLY TO SHOW ZERO POINT OF RAMP.
ADJUST R59-A SO ZERO POINT OF RAMP MATCHES DC LEVEL WHEN RAMP IS NULLED WITH R59-B.
SET R59-C FOR ZERO DC WITH R59-B NULLED.

--- SCOPE TP-4, REPEAT AS ABOVE, USING R60 A-C.

--- SCOPE TP-5, REPEAT AS ABOVE, USING R61 A-C. < Perspective Multiplier Balances.

--- SET 0 @ FF1960, RETURN SCOPE TO NORMAL.

--- FINE TRIM R20-D FOR 0 VOLTS AT BOTTOM J4 IF NECESSARY.

--- SCOPE TP-6.

--- ADJUST R20-B FOR MINIMUM AC.

--- ADJUST R20-C FOR ZERO DC OFFSET.

--- SCOPE TP7, ADJUST R21-B, MINIMUM AC.

--- ADJUST R21-C FOR ZERO DC OFFSET.

--- VERIFY +5V AT TP-8.

BLANKING WINDOW CHECK:

--- SET THE FOLLOWING:

FF1CC0	0
FF1CE0	FFF
FF1D00	0
FF1D20	FFF
FF1D40	0
FF1D60	FFF
FF1960	7FF
FF1920	7FF

--- SCOPE TP-6 AND TOP OF J6 (TOP OF J6 SHOULD BE +5).

--- SET FF1960 TO 8C0. BLANKING AT J6 SHOULD GO LOW AS TP-6 APPROACHES EITHER RAIL. ADJUSTING FF1CC0 AND FF1CE0 SHOULD MOVE THE EDGES.

--- SCOPE TP-7, OBSERVING SAME WITH FF1D00 AND FF1D20.

--- RETURN FF1960 TO 7FF. SET FF1920 TO FFF.

END.

Initialization Table for: VCR (TEST FILE) L 1

Base = FF1CØØ

	(VP Ampl)		(HP Ampl)		(I Ampl)		(VP off)		(HP off)		(I off)		(+V Blkg)		(-V Blkg)
00	L440 7FF	20	7FF	40	7FF	60	L413 7FF	80	7FF	A0	7FF	C0	0	E0	FFF
02		22		42		62		82		A2		C2		E2	
04		24		44		64		84		A4		C4		E4	
06		26		46		66		86		A6		C6		E6	
08		28		48		68		88		A8		C8		E8	
0A		2A		4A		6A		8A		AA		CA		EA	
0C		2C		4C		6C		8C		AC		CC		EC	
0E	0	2E	0	4E	0	6E		8E		AE		CE		EE	
10	FFF	30	FFF	50	FFF	70	FFF	90	FFF	B0	FFF	D0	FFF	F0	FFF
12	0	32	0	52	0	72	0	92	0	B2	0	D2	0	F2	0
14		34		54		74		94		B4		D4		F4	
16		36		56		76		96		B6		D6		F6	
18		38		58		78		98		B8		D8		F8	
1A		3A		5A		7A		9A		BA		DA		FA	
1C		3C		5C		7C		9C		BC		DC		FC	
1E		3E		5E		7E		9E		BE		DE		FE	

Base = FF1DØØ

	(+H Blkg)		(-H Blkg)		(+Z Blkg)		(-Z Blkg)		(ABR1)						
00	0	20	FFF	40	0	60	FFF	80	0	A0		C0		E0	
02		22		42		62		82		A2		C2		E2	
04		24		44		64		84		A4		C4		E4	
06		26		46		66		86		A6		C6		E6	
08		28		48		68		88		A8		C8		E8	
0A		2A		4A		6A		8A		AA		CA		EA	
0C		2C		4C		6C		8C		AC		CC		EC	
0E		2E		4E		6E		8E	$\boxed{C41}$	AE		CE		EE	
10	FFF	30	FFF	50	FFF	70	FFF	90	FFF	B0		D0		F0	
12	0	32	0	52	0	72	0	92	0	B2		D2		F2	
14		34		54		74		94		B4		D4		F4	
16		36		56		76		96		B6		D6		F6	
18		38		58		78		98		B8		D8		F8	
1A		3A		5A		7A		9A		BA		DA		FA	
1C		3C		5C		7C		9C		BC		DC		FC	
1E		3E		5E		7E		9E		BE		DE		FE	

VCR MODS

*PROBLEM: DAC ZERO INADEQUATE RANGE.

SOLUTION: REPLACE ALL 2.2M WITH 100K; R5, 8, 11, 14, 32-38, 49.

*PROBLEM: PERSPECTIVE DIVIDER ADJUST INADEQUATE RANGE.

SOLUTION: REPLACE R67 WITH 5.1K. REPLACE R70 WITH 10K.

*PROBLEM: PCS NEGLECTED NOTE 5 ON SCHEMATIC.

SOLUTION: SHORT PIN 18 + 19 TOGETHER ON U-3 THROUGH U-8.

*PROBLEM: PCS LEFT OFF +/- 15V BYPASS CAPS AT U-90 - U-93.

SOLUTION: COMP SIDE - ADD 1uf CAP: TRACE SIDE - 1uf CAP:

```
COMP SIDE                                                     TRACE SIDE
                                                             ____________________________
         |          U-91          |                          O                          O
         |                        |                          |          U-91            |
         |                        |                          O                          O
  ||===|                          |                          |                          |
  ||     |                        |                         12------|                   O
  ||     |________________________|                          |      |                   |
  ||                                                         O      |                   O
  ||     |   |                                               |    ______                |
   O-----|   |---------@      <---SOLDER TO                  O    ______                O
         |   |+                   GROUND PLANE               |      |  +                |
                                                             9------|                   O
                                                             |                          |
                                                             O__________________________O
```

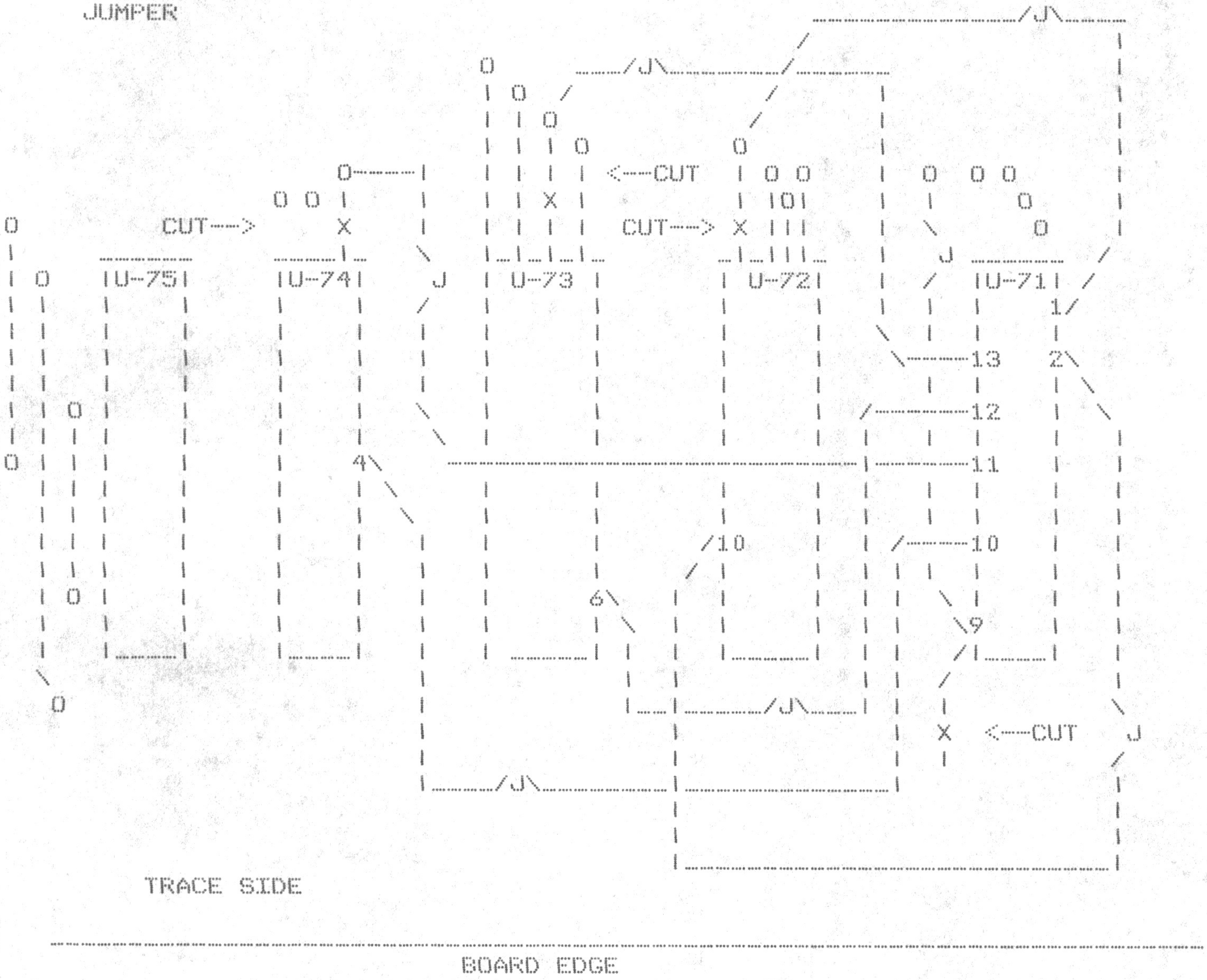
*PROBLEM: DATA INVERTED TO ANALOG MUX'S.

SOLUTION: REPLACE U-76 + 78 WITH 74LS244. CUT 4 PLACES, ADD 7 JUMPERS AS SHOWN: (SEE XEROX)

---U-71 PIN 1 TO HOLE ABOVE U-72;
---U-71 PIN 2 TO U-72 PIN 10;
---U-71 PIN 9 TO HOLE ABOVE U-71;
---U-71 PIN 10 TO U-74 PIN 4;
---U-71 PIN 11 TO HOLE ABOVE U-74;
---U-71 PIN 12 TO U-73 PIN 6;
---U-71 PIN 13 TO HOLE ABOVE U-73.

X = CUT

/J\ = ADD JUMPER



*PROBLEM: INPUT TO U-26 + 27 CONNECTED BY PCS TO PIN 11 OF U-26. (WRONG!)

SOLUTION: 1 CUT, 1 JUMPER AS SHOWN:

```
          COMP SIDE:                                       TRACE SIDE:
                                     |                                               |
       CUT-->                        |                                         \\    |
                                     |                                          ||   |
 __________     |----O      O        |                          __________      ||   |
 |        |     X   __|__  __|__     |                          O        O      ||   |
 |  U-26  |     |   |   |  |   |     |                          |  U-26  |      ||   |
 |        |_____|   |R55|  |R56|     |    O--|  O\    O-----|   O        O      ||   |
 |        |         |   |  |   |     |   ... |  ...\...     |   |        |      ||   |
 |        |         |___|  |___|     |   : : | : :  \: :    |   O        O      ||   O
 |        |           |      |       |   : : | : :   \ :    |   |        |      ||   |
 |        |           O      O       |   :.: | :.:   :\:    |  /O        O      ||   |
                                     |       |         \    |---O/ |     |      ||   |
                                     |       |---O     O \         |     |      ||   |
                                     |                     \       |     |      ||   |
      X = CUT                        |                      \                   ||   |
                                     |                       \                       |
     /J\ = ADD                       |                        \---------/J\----------|
          JUMPER
                                                                         <--ADD
```

*PROBLEM: INTENSITY OFFSET.

SOLUTION: CHANGE R53 TO 20K, ADD 62K FROM U-23 PIN 2 TO PIN 4:

```
                    U-23    BACK
            ___
            | |
             O
          O     O

       O           O          O-------|
                                      |
          O     O                     |
             O             O     @=============
             |                  /
             |_______|  62K  |_____/
                     |_______|
```

*PROBLEM: DIVIDER OUTPUT LEFT OFF BOARD.

SOLUTION: ADD JUMPER FROM BOTTOM OF J4 TO P2-63 (COMP SIDE):

```
     COMP SIDE
                                                                            \
                                      ^                                      J = ADD
                                      |                                     /   JUMPER
                                      |    <---ADD
       /         /         /          \
      |         |         |            J
      |         |         |           /         O    O
      |         |         |           |
 ___TT___TT___TT___TT___TT___TT___TT___TT___TT___TT___
                                     63
```

*PROBLEM: H + V RANGE + CLIPPING.

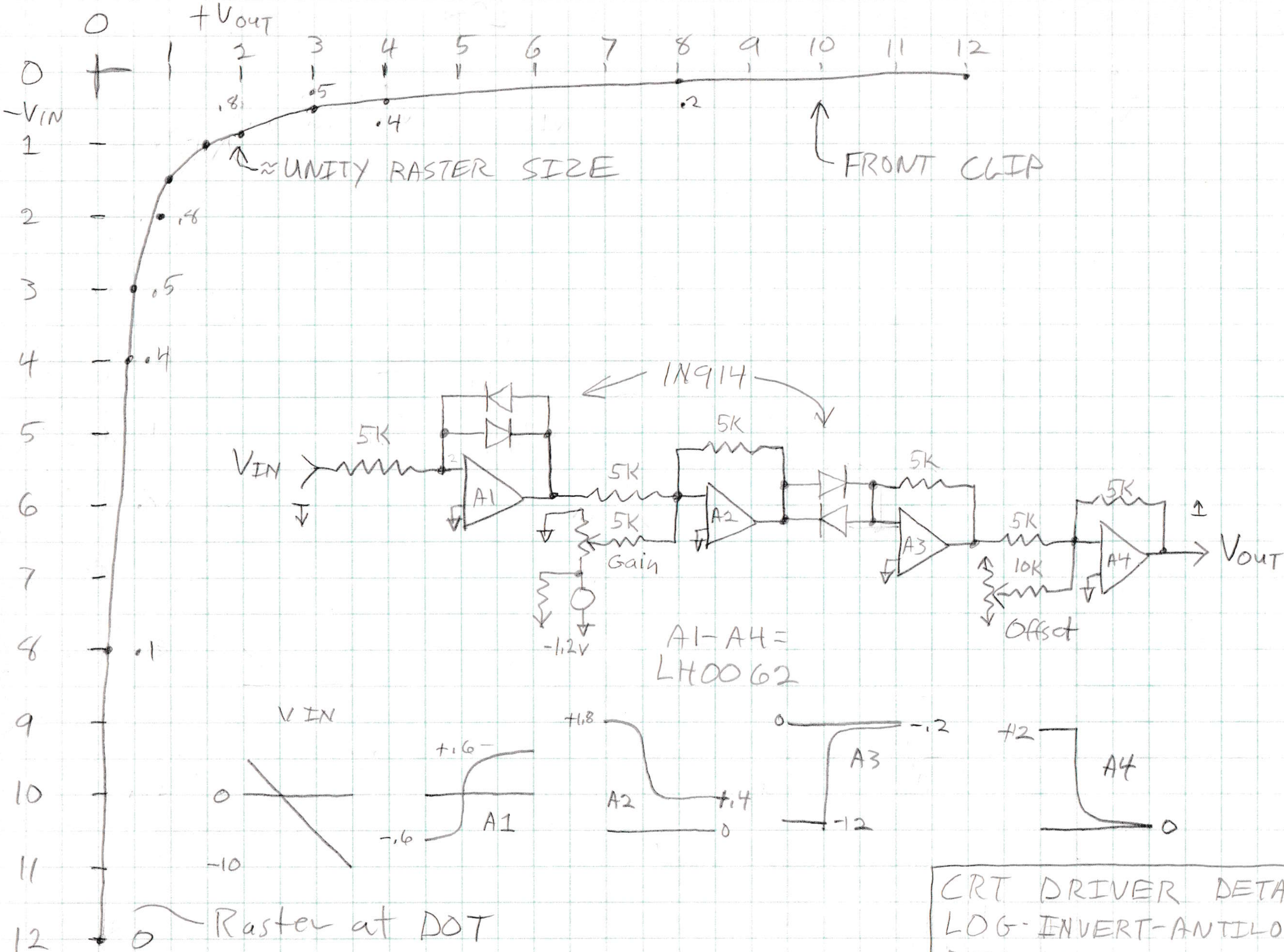
SOLUTION: CHANGE R26 + R43 TO 20K, R23 + R40 TO 5.1K;
---CHANGE CR1, 2, 3, 4 TO IN5232;
---CHANGE R29 + R46 TO 1K, R39 + R22 TO 200 ohms.

*PROBLEM: NOISE.

SOLUTION: RUN INSULATED #18 FROM P2 PINS 1, 3, 5 TO GROUND PLANE AREAS BETWEEN R59 AND U-26, NEAR J5, NEAR R39, AND NEAR J1 + J2.

*PROBLEM: Z BLANKING RANGE.

SOLUTION: CHANGE R57 TO 20K, CONNECT TO -15 INSTEAD OF GROUND.



Adjust with offset pot
for Zero Out.

CRT DRIVER DETAIL -
LOG-INVERT-ANTILOG
PERSPECTIVE DIVIDER

DWS 9-1-82

VCR

Stuffing List for VCR100A

Reference No's	Part Name	Part Type	Description
C1	Reference not found in component list		
C2-3	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C4	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C5	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C6	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C7	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C8-25	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C26-27	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C28	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C29	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C30	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C31	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C32-49	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C50-51	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C52-53	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C54	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C55	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C56	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C57-94	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C95	Reference not found in component list		
C96	AD589JH	No description found in cross ref file	
CR1-10	1N5240B	DIODE	10V ZENER DIODE — DIODES?
CR 1-4	1N5232		
J1-3	COAX JACK	CONNECTOR	AMPHENOL SMA COAX JACK
R1	R 3.32K OHM 1/4W 1%	RESISTOR	3.32K OHM 1/4W 1% RESISTOR
R2-4	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R5 100K	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R6-7	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R8 100K	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R9-10	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R11 100K	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R12-13	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R14 100K	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R15-17	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R18	Reference not found in component list		
R19	Reference not found in component list		
R20-21	RV MFT 7104D-410-103	No description found in cross ref file	
R22	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R24-27	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R28	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
~~R29~~-30	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R31-38 R32-39 100K	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R39	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R40-44	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R45	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R46-47	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R48-49 R49 100K	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R50	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR

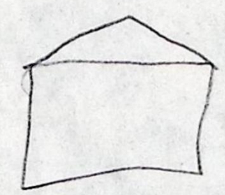
R23 - 5.1K
R26 - 20K

R29 1K
R40 - 5.1K
R43 - 20K
R46 - 1K

Reference No's	Part Name	Part Type	Description
R53-	R 20K OHM		
R51-54	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R55	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R56-57	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R58	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R59-61	RV MFT 7104D-410-103	No description found in cross ref file	
R62	R 3.32K OHM 1/4W 1%	RESISTOR	3.32K OHM 1/4W 1% RESISTOR
R63	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
R64-66	R 5K OHM 1/4W 1%	No description found in cross ref file	
R67	5.1K — R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R68-69	R 5K OHM 1/4W 1%	No description found in cross ref file	
R70	10K — R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R71-72	R 5K OHM 1/4W 1%	No description found in cross ref file	
R73	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R74-79	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
SU1-12	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SU13-28	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SU29-77	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU78-86	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU87-93	DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET
SU94-96	RND SOCKET-8 ST	SOCKET	8 PIN SOLDER TAIL ROUND SOCKET
SU97-99	RND SOCKET-10 ST	SOCKET	10 PIN SOLDER TAIL ROUND SOCKET
SW1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
TP1-20	TEST-POINT STUD	HARDWARE	BOARD STUD TEST POINT
U1	Reference not found in component list		
U2	7433	IC	QUAD 2-INPUT NOR BUFFERS W/OC OUTPUTS
U3-8	DAC-80	IC	12 BIT DAC WITH OP AMP
U9	HA2535	IC	FAST FET OP-AMP
U10-11	NE527	IC	FAST COMPARATOR
U12-13	4298	IC	FAST ANALOG MULTIPLIER
U14	HA2535	IC	FAST FET OP-AMP
U15-16	NE527	IC	FAST COMPARATOR
U17-22	DAC-80	IC	12 BIT DAC WITH OP AMP
U23	HA2535	IC	FAST FET OP-AMP
U24-25	HI506	IC	16X1 ANALOG SW
U26-27	NE527	IC	FAST COMPARATOR
U28-51	DM8599	IC	16X4 RAM
U52-53	HI506	IC	16X1 ANALOG SW
U54-56	AD533JH	IC	ANALOG MULTIPLIER
U57-68	DM8599	IC	16X4 RAM
U69-70	HI506	IC	16X1 ANALOG SW
U71	74LS04	IC	HEX INVERTER
U72-75	DM8599	IC	16X4 RAM
U76	74LS240	IC	OCTAL BUS DRIVER
U77	74LS244	IC	OCTAL BUS DRIVER
U78	74LS240	IC	OCTAL BUS DRIVER

Stuffing List for VCR100A

Reference No's	Part Name	Part Type	Description
U79	74LS244	IC	OCTAL BUS DRIVER
U80	74LS240	IC	OCTAL BUS DRIVER
U81	74157	No description found in cross ref file	
U82-83	74138	No description found in cross ref file	
U84	74LS240	IC	OCTAL BUS DRIVER
U85-86	25LS2521	IC	8 BIT COMPARATOR
U87	74LS260	IC	DUAL 5-INPUT NOR GATE
U88	74S74	IC	DUAL D FLIP-FLOP
U89	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U90-93	LH0062	IC	FET OP-AMP

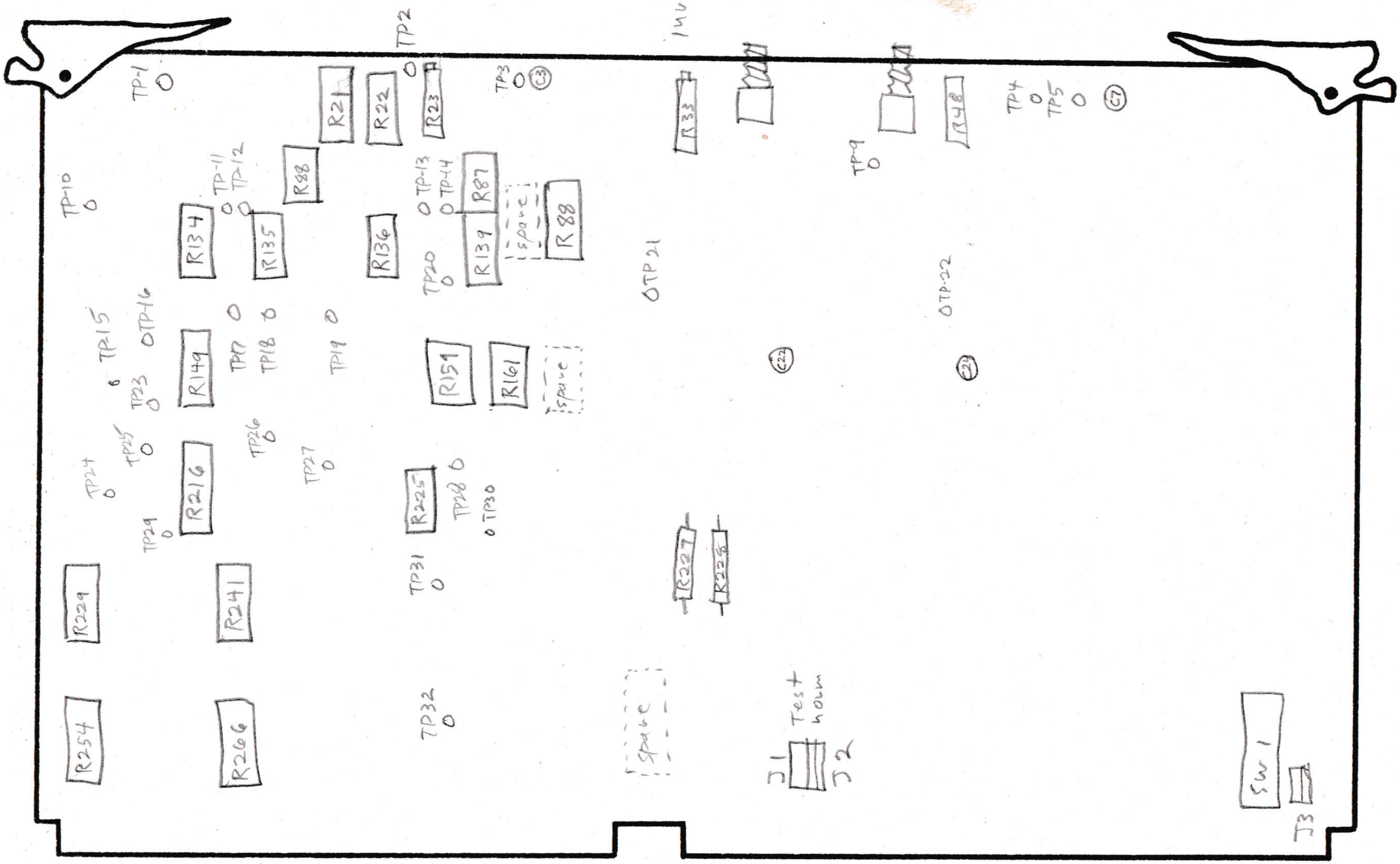


Reference No's	Total	Part Name	Part Type	Description
C2-3,5,7,26-27,29, 31,50-51,54,56	12	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C4,6,28,30,52-53,55, 57-94	45	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C8-25,32-49	36	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C96	1	AD589JH	No description found in cross ref file	
CR1-10	10	1N5240B	DIODE	10V ZENER DIODE
J1-3	3	COAX JACK	CONNECTOR	AMPHENOL SMA COAX JACK
R1,62	2	R 3.32K OHM 1/4W 1%	RESISTOR	3.32K OHM 1/4W 1% RESISTOR
R2-4,6-7,9-10,12-13, 15-17,73	13	RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT
R5,8,11,14,28,31-38, 45,48-49,55,58	18	R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR
R20-21,59-61	5	RV MFT 7104D-410-103	No description found in cross ref file	
R22,39,50	3	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R23-27,29-30,40-44, 46-47,51-54,56-57, 74-79	26	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R63	1	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
R64-66,68-69,71-72	7	R 5K OHM 1/4W 1%	No description found in cross ref file	
R67,70	2	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
SU1-12	12	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SU13-28	16	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SU29-77	49	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU78-86	9	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU87-93	7	DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET
SU94-96	3	RND SOCKET-8 ST	SOCKET	8 PIN SOLDER TAIL ROUND SOCKET
SU97-99	3	RND SOCKET-10 ST	SOCKET	10 PIN SOLDER TAIL ROUND SOCKET
SW1	1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
TP1-20	20	TEST-POINT STUD	HARDWARE	BOARD STUD TEST POINT

Reference No's	Total	Part Name	Part Type	Description
U2	1	7433	IC	QUAD 2-INPUT NOR BUFFERS W/OC OUTPUTS
U3-8,17-22	12	DAC-80	IC	12 BIT DAC WITH OP AMP
U9,14,23	3	HA2535	IC	FAST FET OP-AMP
U10-11,15-16,26-27	6	NE527	IC	FAST COMPARATOR
U12-13	2	429B	IC	FAST ANALOG MULTIPLIER
U24-25,52-53,69-70	6	H1506	IC	16X1 ANALOG SW
U28-51,57-68,72-75	40	DM8599	IC	16X4 RAM
U54-56	3	AD533JH	IC	ANALOG MULTIPLIER
U71	1	74LS04	IC	HEX INVERTER
U76,78,80,84	4	74LS240	IC	OCTAL BUS DRIVER
U77,79	2	74LS244	IC	OCTAL BUS DRIVER
U81	1	74157	No description found in cross ref file	
U82-83	2	74138	No description found in cross ref file	
U85-86	2	25LS2521	IC	8 BIT COMPARATOR
U87	1	74LS260	IC	DUAL 5-INPUT NOR GATE
U88	1	74S74	IC	DUAL D FLIP-FLOP
U89	1	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U90-93	4	LH0062	IC	FET OP-AMP

BOARD ______________________ VER. ____________________

+15 500ma
-15 600ma



FF2000

1 119 1 139

P2 P1

VID

VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17	X/X IN @	18	
19	X/Y IN @	20	
21	X/Z IN @	22	
23	Y/X IN @	24	
25	Y/Y IN @	26	
27	Y/Z IN @	28	
29	ZP/X IN @	30	
31	ZP/Y IN @	32	
33	ZP/Z IN @	34	
35	TX IN @	36	
37	TY IN @	38	
39	TZ IN @	40	
41	ZREF IN @	42	
43	X/ZMSB	44	
45	Y/ZMSB	46	
47	XAM IN @	48	
49	XS IN @	50	
51	YAM IN @	52	
53	YS IN @	54	
55	VPM IN @	56	
57	HPM IN @	58	
59	VINT IN @	60	
61	INT IN @	62	
63	ZOUT IN @	64	
65		66	
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane.
ALL other pins are.

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

DWS 10/6/82

UID BOARD

- Revision of Previous Spec...
  * Delete Scan rate selection switches.
  * Delete Flying spot channel functions.

- Precision of Rescan Channel functions:

	Address:		Function	Range	
FF2000	Base + Ø	400	Level 1 encode	0-4095	4095=max
	Base + 2	0	Level 2 encode	0-4095	
	Base + 4	0	Level 3 encode	0-4095	
	Base + 6	0	Level 4 encode	0-4095	
	Base + 8	0	Gray 1 Intensity	0-4095	
	Base + A	FFF	Gray 2 Intensity	0-4095	
	Base + C	0	Gray 3 Intensity	0-4095	
	Base + E	0	Gray 4 Intensity	0-4095	
	Base + 10	0	Gray 5 Intensity	0-4095	
	Base + 12	7FF	Point Intensity	0-4095	7FF norm
	Base + 14		SPARE D/A's	0-4095	
	Base + 16				
	Base + 18		Control Register	0-255	

Bit#	Function	True	
0	Invert	Hi	Inverts Video
* 1	Analog	Hi	outputs Analog v
* 2	Encode	Hi	outputs Encoded v
3-7	Spare		

* Analog and Encode can both be active simultan...
  At least one must be on. Default should be Anal...

FOR BOTH THE RESCAN AND FLYING SPOT CHANNELS SCAN RATES ARE SELECTABLE.

THERE ARE 3 FOUR POSITION SWITCHES:

HI-RES HORIZONTAL
- GENERATOR HI-RES
- PROGRAMMABLE
- GRAPHICS
- SYNC STRIPED HORIZONTAL

LO-RES HORIZONTAL
- GENERATOR LO-RES
- PROGRAMMALBE
- SPARE
- SYNC STRIPED HORIZONTAL

VERTICAL
- GENERATOR
- SPARE
- SPARE
- SYNC STRIPED VERTICAL

RESCAN CHANNEL FUNCTIONS:

	GAMMA POINT INTENSITY	0 - 255 4095 ← SEGMENTED
FF2000	LEVEL 1 ENCODE	0 - 255
2	LEVEL 2 ENCODE	0 - 255
4	LEVEL 3 ENCODE	0 - 255
6	LEVEL 4 ENCODE	0 - 255
8	GRAY 1 INTENSITY	0 - 255
A	GRAY 2 INTERSITY	0 - 255
C	GRAY 3 INTERSITY	0 - 255
E	GRAY 4 INTERSITY	0 - 255
10	GRAY 5 INTERSITY	0 - 255
12	point int	
	CONTROL REGISTER	

Spares 14+16

Ø-4095 ← SX, SY, SZ — SEGMENTED FOR RESCAN; NOT SEGMENTED FOR FLYING SPOT

BIT
18 0 - NORMAL / INVERT

FLYING SPOT CHANNEL FUNCTIONS:

~~GAMMA 1~~	~~0 - 255~~
~~GAMMA 2~~	~~0 - 255~~
~~GAMMA 3~~	~~0 - 255~~

POINT INTENSITY

0 - 4095 ← NOT SEGMENTED

CONTROL REGISTER

BIT
0 - NORMAL / INVERT 1
1 - NORMAL / INVERT 2
2 - NORMAL / INVERT 3

Init. system with TEST - L1

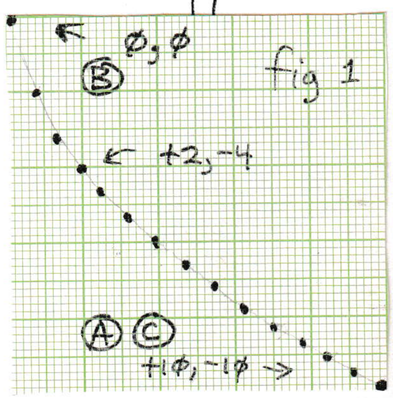
- Verify ØV at TP 18 and TP 26
- Scope TP 27, turn R23 all the way CCW. Set R135-D for ØV.
- Scope TP-21 on VCR, verify that it is at -1.4V. (Adjust R4 on VRM if neccessary)
- Scope TP-27, adjust R23 CW to get +1.4V (some noise present)
- With scope in dual-trace mode, scope VCR-TP2 on trace A, VID-TP27 on trace B.
- Set ØØØ at FF1960, Trace A should be ØV. Trim R-135-D to make Trace B the same (ØV.)
- Set 7FF at FF1960, trim VID R-23 to match A and B traces.
- Repeat last 2 steps until traces match with ØØØ and 7FF.

(NOTE: I = 800 until stated otherwise)

- Set I = 800 ØØØ at FF1960, Enable RAMP AT VERT RATE (F8) Scope to single trace.
- Scope TP 18 + TP 26 to verify ≈ ØV.
- Scope TP 16, adjust R159-C for minimum AC signal. Adj. R159-B for ØV.
- Scope TP 25 and adjust R225-C for minimum AC signal. Adj R 225-B for ØV.
- Scope TP-18. Set FF1960 = ØØØ. Address FF18EØ, DIS-ABLE RAMP. Set Data to ØØØ, and enable ramp. Set R159-D for Ø to +10V. Move probe to TP 16, adjust R-159-A for minimum AC, re-trim R159-B for ØV offset if neccessary.

- Disable Ramp, set 7FF at FF18EØ, address FF186Ø, put D=ØØØ. Enable Ramp, adjust R225-D for Ø to +1Øv at TP26.
- Scope TP25, trim R225-A for minimum AC, re-trim R225-B for Øv offset if neccessary.
- Disable Ramp, set 7FF at FF186Ø. Set FF1920=ØØØ enable Ramp. Adjust R149-A for minimum AC at TP15. Adj R149-B for Øv offset.
- Disable Ramp, set 7FF at FF192Ø, Set FF19ØØ=ØØØ enable Ramp. Adjust R216-A for minimum AC at TP-24. Adj R 216-B for Øv offset.
- Disable Ramp, set FF18EØ=ØØØ, FF1860=ØØØ, FF19ØØ=7FF, FF196Ø=ØØØ.
- Enable Ramp, scope TP-15, trim R149-C for min. AC. Retrim R149-B for Øv offset if necc.
- Scope TP-24, trim R216-C for min AC. Re-trim R216-B for Øv offset if neccessary.
- Disable ramp, set FF18EØ=7FF, FF1860=7FF, FF1960=7FF,
- Set FF1920=80Ø, FF18AØ=7FF, FF1820=7FF, scope TP-31. Adjust R229-B and R241-B for max positive
- Set FF19ØØ=8ØØ, FF1800=7FF, FF1880=7FF, scope TP-32. Adjust R-254-B and R266-B for max. positive
- Set FF192Ø=7FF, scope TP31. Adjust R229-C and R241-C for max. positive
- Set FF19ØØ=7FF, Scope TP32. Adjust R254-C and R266-C for max. positive

- Reload with L1 Verify -1Øv at TP31 + TP32.
- Set 7FF at FF18ØØ. Set Inc. = 1ØØH. Set FF15ØØ = ØØØ enable ramp, scope TP17. Adjust R134-D for minimum AC, Adj. R134-C for Øv offset. Disable ramp, set FF15ØØ = 7FF, FF18ØØ = ØØØ, Enable ramp. Trim R134-B for minimum AC, Retrim R134-C for Øv. disable ramp, set FF18ØØ = ØØØ, FF15ØØ = ØØØ
- Scope TP19. Set FF18AØ = 7FF. Set FF14CØ = ØØØ enable ramp. Trim R136-D for minimum AC. Trim R136-C for Øv. Disable Ramp, set FF14CØ = 7FF Set FF18AØ = ØØØ. Enable Ramp. Trim R136-B for minimum AC. Re-trim R136-C for Øv. Disable Ramp set FF18AØ = ØØØ, FF14CØ = ØØØ.
- Scope TP19. Set R136-A for +1Øv. Address FF15ØØ = ØØØ,
  Scope TP17, Set R134-A for +1Øv.
  Set Increment = 8Ø, enable ramp.
  Scope in XY mode, gnd. inputs, set dot at upper left corner as in fig 1.
  put X probe to TP-17, Y probe to TP28. Adjust R135-A for lower right dot to be at +1Ø, -1Ø. Adjust R135-B so that upper left dot just reaches Ø,Ø. Re-trim +1Ø, -1Ø with R135C,



- Disable Ramp, set ØØØ at FF15ØØ. Set ØØØ at FF14CØ, Enable Ramp. Move X + Y probes to TP19 + TP-2Ø, adjust R139 A, B, C as in fig 1. Disable Ramp, Set FF15ØØ = 7FF, Set FF14CØ = 7FF.

- [NOTE: VVG must be removed for remainder of setup]

- Return scope to normal, 1 trace, scope TP 30, Trim R161-C for 0V. Set FF14C0=0, set FF1500=0, Inc = 100H. Enable Ramp. Adj R161-B for negative peak of signal to fall at +2v. Disable Ramp, set FF1500=0, FF14C0=0, enable ramp. Set R161-D for negative peak of signal to fall at +2v.

- Disable Ramp. Set FF1500=0, FF14C0=0 FF1CA0=0, Inc= 100H, Enable Ramp. Scope in X/Y mode, X probe to TP-2, Y probe to TP-12. Set R22A max CW. Adjust R22D as in fig 1 for +10,-10. Adjust R22-B for 0,0 point, and trim +10,-10 with R 22C.

- Disable Ramp. Set FF1500=000, FF14C0=000, FF1CA0=000. Enable Ramp. Trim R86-A for negative peak to fall at 0v, at TP-14. Disable Ramp. Set FF1500=7FF, FF14C0=7FF, FF1CA0=000, Enable Ramp. Trim R86-C for minimum AC. Trim R86-B for 0v offset.

- Disable Ramp. Set FF1500=000, FF14C0=000, FF1CA0= 000, FF1960= 000, Inc=100H Enable Ramp. (Set R87-A CCW) Scope TP-13. Trim R87-D for minimum AC, Trim R87C for 0VDC. Disable Ramp, set FF1CA0=FFF, Set FF1960=000. Enable Ramp, trim R87-B for negative peak to fall at 0v. Adjust R87-A for positive peak to be +6 V.
- Verify video present at TP-22. Turn R48 maxCW, verify video clamped at 0V at TP-4. (Hatch reccomended) with ramp still running, trigger on negative peak at TP-13, observe TP3. Trim R-88D for minimum video in negative peak. Trim R-88A for 0v offset during negative peak. Trim R-88C for black level to remain at 0v regardless of Amplitude. (sync will go negative)

- Return scope to normal, 1 trace.

Scope TP3Ø. Trim R161-C for ØV.
Set FF14CØ = ØØØ, set FF15ØØ = ØØØ, Inc = 1ØØH.
Enable Ramp. Adj. R161-B for negative peak of signal to fall at +2V. Disable Ramp, set FF15ØØ = ØØØ, FF14CØ = ØØØ, enable ramp. Set R161-D for negative peak to fall at +2V.

- Return scope to normal, 1 trace, move probe to TP14. Adjust R86-A for positive peak to be ØV. Disable Ramp. Set FF15ØØ to 7FF, FF14CØ = 7FF, FF KAØ = Ø, Enable ramp. Trim R86-C for minimum AC, trim R86-B for ØV.

Disable Ramp
FF1500=0
FF14C0=0

- Scope to X/Y mode, Xprobe to TP-8, Y probe to CR21 anode. Adjust R284 A+C for +1Ø, -12, adjust R284-B for Dot to just reach Ø,Ø.
(note, R87A is full cw)

VIDEO. BOARD ADJUST. 2/3

V RAMP	TP	Addr.	Data	V	R. adj.
	31	$FF1920	8ØØ		
		18AØ	7FF		
		182Ø	7FF	Ø	229.b
				Ø	241.b
	32	$FF 19ØØ	8ØØ		
		18ØØ	7FF		
		188Ø	7FF	Ø	254.b
				Ø	266.b
	31	$FF192Ø	7FF	Ø	229.c
				Ø	241.c
	32	$FF 1900	7FF	Ø	254.c
				Ø	266.c

RE-LOAD SYSTEM with L1

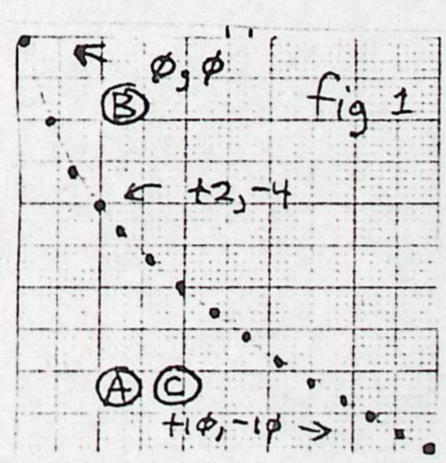
(I = 100)

V RAMP	TP	Addr.	Data	V	R. adj.
	31			−10	
	32			−10	
		$FF 1800	7FF		
		1500	Ø		
Enable	17			At min	134.d
				Ø	134.c
Desable		$FF 1800	Ø		
		1500	7FF		
Enable				At min	134.b
				Ø	134.c
Desable		$FF 1800	Ø		
		1500	Ø		
	19	18AØ	7FF		
		14CØ	Ø		
Enable				At min	136.d
				Ø	136.c
Desable		$FF 18AØ	Ø		
		14CØ	7FF		
Enable				At min	136.b
				Ø	136.c
Desable		$FF 18AØ	Ø		
	19	14CØ	Ø	+10	136.a
	17	15ØØ	Ø	+10	134.a

(I = 80)

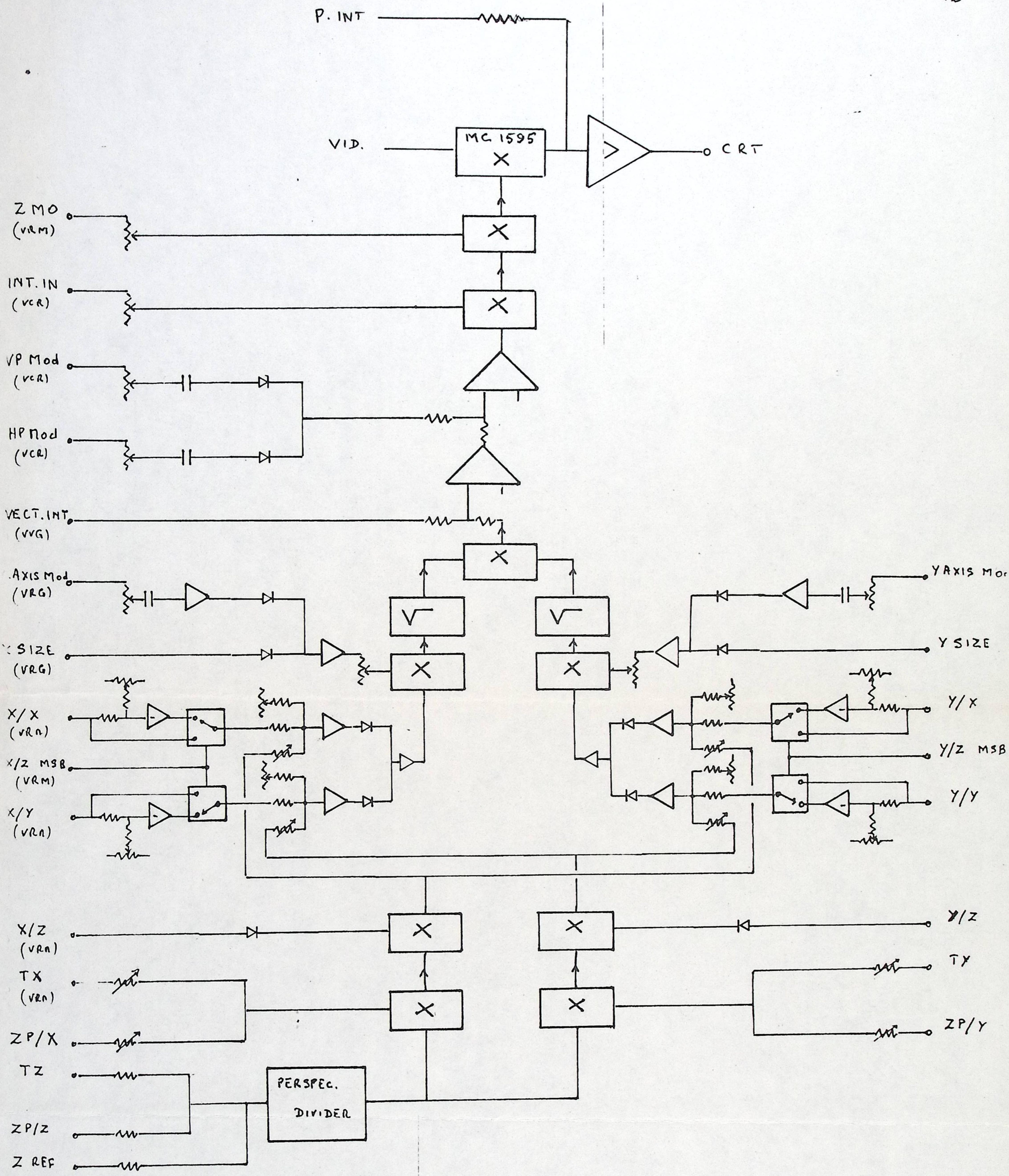
V RAMP	TP	Addr.	Data	V	R. adj.
Enable	17			+10	135.a
	28			−10	
	17			Ø	135.b
	28			Ø	
	17			+10	135.c
	28			−10	
Desable		$FF 1500	Ø		
		14CØ	Ø		

probe X, probe Y: - Scope in XY mode
- dot in upperleft when inputs = gnd

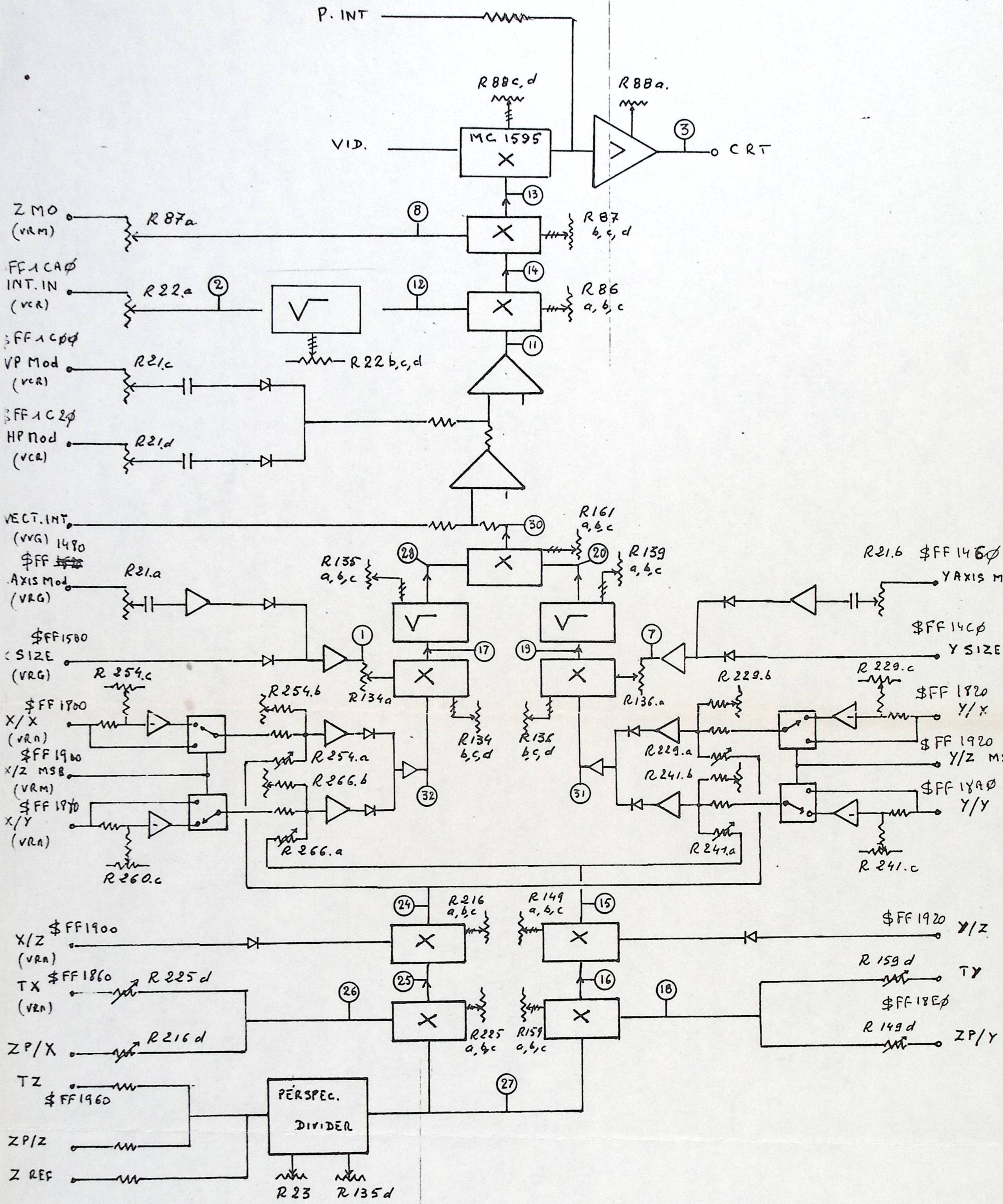


VIDEO · BOARD ADJUST 3/3

	V RAMP	TP	Addr.	Data	V	Radj.	
	Enable	19			+10	139.a	probe X } scope in X.Y mode
		20			-10		probe Y
		19			∅	139.b	
		20			∅		
		19			+10	139.c	
		20			-10		
	Desable		$FF 1500	7FF			
			14C∅	7FF			
VVG Removed		3∅			∅	161.c	Scope : one trace
			$FF 14C∅	∅			
			1500	∅			
(INC = 100)	Enable				+2	161.b	negative peak of signal falls at +2v
	Desable		$FF 1500	∅			
			14C0	∅			
	Enable				+2	161.d	id.
	Desable		$FF 14C∅	∅			
			1500	∅			
			1CA∅	∅			
(INC = 100)	Enable	2					X probe
		12					Y probe
						22.a	max CW
						22.d	for X = +10, Y = -10
						22.b	for X = Y = ∅
						22.c	for X = +10, Y = -10
	Desable		$FF 1CA∅	∅			
			14C∅	∅			
			1500	∅			
	Enable	14			∅	86.a	negative peak of signal falls at ∅ v
	Desable		$FF 1500	7FF			
			14C∅	7FF			
			1CA∅	∅			
	Enable				At min	86.c	
					∅	86.b	
	Desable		$FF 1CA∅	∅			
			14C∅	∅			
			196∅	∅			
			150∅	∅			
	Enable	13				87.a	max CCW
					At min	87.d	
					∅	87.c	
	Desable		$FF 1CA∅	FFF			
			196∅	∅			
	Enable				∅	87.b	negative peak of signal falls at ∅v
					+6	87.a	positive peak is +6v


P. INT
VID.
MC 1595
CRT
ZMO (VRM)
INT. IN (VCR)
VP Mod (VCR)
HP Mod (VCR)
VECT. INT (VVG)
AXIS Mod (VRG)
SIZE (VRG)
X/X (VRA)
X/Z MSB (VRM)
X/Y (VRA)
YAXIS Mo
Y SIZE
Y/X
Y/Z MSB
Y/Y
X/Z (VRA)
TX (VRA)
ZP/X
TZ
ZP/Z
Z REF
PERSPEC. DIVIDER
Y/Z
TY
ZP/Y

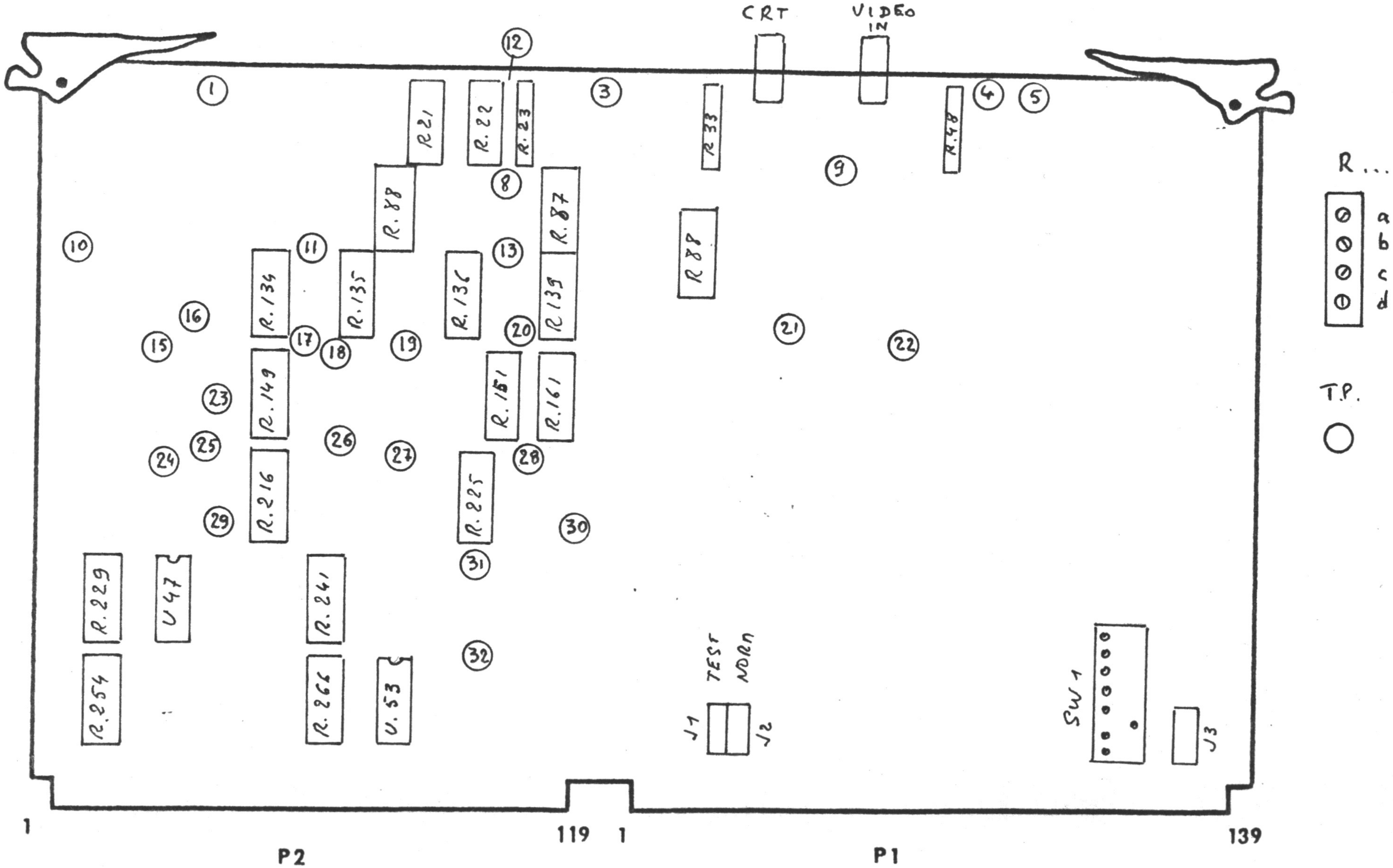
VID. 2/2


P. INT
R88c,d
R88a.
VID.
MC 1595
CRT
ZMO
(VRM)
R87a
R87
b, c, d
FF1CA0
INT. IN
(VCR)
R22.a
R86
a, b, c
R22 b,c,d
$FF1C00
VP Mod
(VCR)
R21.c
$FF1C20
HP Mod
(VCR)
R21.d
VECT. INT
(VVG)
R161
a, b, c
$FF 1480
R135
a, b, c
R139
a, b, c
R21.b
$FF 1460
AXIS Mod
(VRG)
R21.a
Y AXIS Mod
$FF1580
SIZE
(VRG)
$FF14C0
Y SIZE
R134a
R136.a
R254.c
R254.b
R229.b
R229.c
$FF 1900
X/X
(VRA)
$FF 1820
Y/X
R254.a
R134
b, c, d
R136
b, c, d
R229.a
$FF 1900
X/Z MSB
(VRM)
$FF 1920
Y/Z MSB
R266.b
R241.b
$FF 18A0
$FF 1840
X/Y
(VRA)
Y/Y
R266.a
R241.a
R260.c
R241.c
R216
a, b, c
R149
a, b, c
X/Z
$FF1900
(VRA)
$FF1920
Y/Z
TX
$FF1860
(VRA)
R225d
R159 d
TY
$FF18E0
R225
a, b, c
R159
a, b, c
ZP/X
R216d
R149 d
ZP/Y
TZ
$FF1960
PERSPEC.
DIVIDER
ZP/Z
Z REF
R23
R135d

VIDEO BOARD : MC 1595 and output stage

V Ramp	TP			V	R adj.	
Enable	22					Video present
					48	max CW
	4			Ø		video clamped at Øv
	13					trigger scope on negative edge
	3				88 d	minimum video in negative peak
				Ø	88 a	Øv offset during negative peak
				Ø	88 c	black level = Ø, regardless of amplitude

BOARD VID. VER.



Initialization Table for: VID (TEST FILE) L1

Base = FF2000

00	4000	20		40		60		80		A0		C0		E0	
02	0	22		42		62		82		A2		C2		E2	
04	0	24		44		64		84		A4		C4		E4	
06	0	26		46		66		86		A6		C6		E6	
08	0	28		48		68		88		A8		C8		E8	
0A	FFF	2A		4A		6A		8A		AA		CA		EA	
0C	0	2C		4C		6C		8C		AC		CC		EC	
0E	0	2E		4E		6E		8E		AE		CE		EE	
10	0	30		50		70		90		B0		D0		F0	
12	7FF	32		52		72		92		B2		D2		F2	
14	0	34		54		74		94		B4		D4		F4	
16	0	36		56		76		96		B6		D6		F6	
18	4	38		58		78		98		B8		D8		F8	
1A		3A		5A		7A		9A		BA		DA		FA	
1C		3C		5C		7C		9C		BC		DC		FC	
1E		3E		5E		7E		9E		BE		DE		FE	

Base =

00		20		40		60		80		A0		C0		E0	
02		22		42		62		82		A2		C2		E2	
04		24		44		64		84		A4		C4		E4	
06		26		46		66		86		A6		C6		E6	
08		28		48		68		88		A8		C8		E8	
0A		2A		4A		6A		8A		AA		CA		EA	
0C		2C		4C		6C		8C		AC		CC		EC	
0E		2E		4E		6E		8E		AE		CE		EE	
10		30		50		70		90		B0		D0		F0	
12		32		52		72		92		B2		D2		F2	
14		34		54		74		94		B4		D4		F4	
16		36		56		76		96		B6		D6		F6	
18		38		58		78		98		B8		D8		F8	
1A		3A		5A		7A		9A		BA		DA		FA	
1C		3C		5C		7C		9C		BC		DC		FC	
1E		3E		5E		7E		9E		BE		DE		FE	

VID MODS

*** IMPORTANT!!! MUST BE DONE BEFORE FIRING UP VID101A! ***

*PROBLEM: PCS MISCONNECTED +5 TO GND.

SOLUTION: CUT FINGERS OFF!!!

```
COMPONENT SIDE:                  |     TRACE SIDE:
                                 |
                     1           |                 |  |
     ____________   ______       |                _|  |_  ____________
     |          |   |O  O|       |                |O  O|  |          |
     |          |   |----|       |                |----|  |          |
P2   |          |   ||  XX   P1  |          P2    XXXXXX  |          |   P1
_____|          |___||__XX___    |        ________XXXXXX__|          |_____
                                 |
               REMOVE--->                 REMOVE--->
```

*PROBLEM: ADDRESS MODIFIER BITS SWAPPED.

SOLUTION: CUT 2, JUMP 2:

```
                                                                  X = CUT
                             COMPONENT SIDE                      \
                                                                 J = ADD JUMPER
___________               ________________________________        \
 _______    \             /   _____________________________
         \   \           /   /
          \   \         /   /   P 1                 O\    O\
           \   \_______/   /                        | \   | \   <---ADD
            \ O _______ O /               CUT---> X  J  X  J
             | |       | |                       |   \ |   \
    ____TT___| |__TT___| |__TT___TT___TT___TT___TT___TT___TT___TT_____
                                                81   83   85
```

*PROBLEM: R66 CONNECTED TO GND, INSTEAD OF -5.

SOLUTION: REMOVE R66, SCRAPE GND FROM COMP. SIDE:

```
 __      __
   \    /
    |  |
    XXX
     O          <---BOTTOM OF R66
    XXX
    |  |
 __/    \__
```

---REPLACE R66 WITH 475 ohms, JUMPER BOTTOM R66 TO BOTTOM R56.

*PROBLEM: R48 INADEQUATE RANGE.

SOLUTION: REPLACE R64 WITH 3.0 ohms.

*PROBLEM: CLAMP ERRORS.

SOLUTION: ADD -200K, REAR OF BOARD FROM BOTTOM R90 TO TOP R91;
-360K, REAR OF BOARD FROM BOTTOM R94 TO TOP R91.

*PROBLEM: GREY LEVEL REF VOLTAGE CHANGE.

SOLUTION: RESISTOR VALUE CHANGES AS FOLLOWS:

PART	WAS	NOW
R184	1.16K	2.0K
R185	400ohms	JUMPER
R186	1.6K	2.0K
R187	400ohms	100ohms
R191\		
R193 >	10K	20K
R196 >		
R198/		
R279	2.2K	470ohms
R50	680ohms	322ohms

*PROBLEM: PCS INCORRECTLY CONNECTED U-6.

SOLUTION: JUMPER PIN 8 TO 10, AND PIN 9 TO U-42 PIN 2.
---CONNECT 2.2M FROM PIN 1 TO +15V.

*PROBLEM: RESPONSE + AMPL OF GREY LEVELS.

SOLUTION: REPLACE C7 WITH 220pf, PUT 24 ohms RESISTOR BETWEEN TP-5 AND GROUND.

*PROBLEM: WRONG RESISTOR INSTALLED IN R28 (470 ohms).

SOLUTION: SHOULD BE 51 ohms.

*PROBLEM: INADEQUATE BYPASS, VIDEO MULTIPLIER.

SOLUTION: INSTALL 1uf NEAR R24 SYMBOL AND NEAR R31 SYMBOL:

```
  COMP SIDE:         ____________________
                     O___________________                        |          |
                     |    ___________                            |  U - 4   |
                     |   |           |                           |          |
                     |   |   U-3     |                           |          |
                    +|   |___________|                           |__________|
 ____H____        ___|___                                    R31
 | R23   |        _______       <---ADD          _____________________________
 |       | R24       |                        _____________O______________
 |       |           |GND PLANE                            |
 |       |                                              ___|___
                                                        _______       <---ADD
                                                           | +
                                                           |
                                                       GND PLANE
```

*PROBLEM: PCS OMITTED -15 TO U-10.

SOLUTION: CONNECT AS FOLLOWS:

```
     TRACE       0    |    |    |     |       0
     SIDE             |    |    |     |
                 0    |    |    |     |       0
     U-10             |    |    |     |
                 0    |    |    |     |       0
                      |    |    |     |_______
      ADD--->    0====|    |    |      _______0|
                      |    |    |     |
                 0    |    |    |     |       0
                      |    |    |     |
                 0    |    |    |     |       0
                      |    |    |     |
                 0    |    |    |     |       0
```

*PROBLEM: ANALOG AND ENCODE BITS SWAPPED (PCS).

SOLUTION: TABLE CHANGE IN SOFTWARE.

*PROBLEM: SENSE OF HB INVERTED.

SOLTUION: CUT TRACE BETWEEN U-42 + U-43 (COMPONENT SIDE).
---ADD TRACE FROM U-42 PIN 9 + 10, AND FROM U-42 PIN 8 TO PAD NEAR PIN 13 (TRACE SIDE).

```
                                                  |
                                                  |                    0    @    0
 __________                 ___________           |                         |
|          |______         |           |          |                    0    |    0
|   U-42   |      |        |   U-43    |          |                         |
|          |      X        |           |          |                    0    |    0
|          |______|        |           |          |                         |
|          |               |           |          |                    0    |    0
|__________|               |___________|          |                         |
                                                  |                    0    |    0
                  <---CUT                         |       ADD--->      |    |
                                                  |                    0    |    0
                                                  |                         |
                                                  |       ADD--->      0----|    0
                                                  |
              COMP SIDE                                      TRACE SIDE
```

*PROBLEM: -15 LEFT OFF U-22.

SOLUTION: JUMPER FROM U-21.

*PROBLEM: CLAMP ERRORS.

SOLUTION: CHANGE R162 + R173 TO 680 ohms.

VID

Reference No's	Total	Part Name	Part Type	Description
C1-2,10-11	4	C 1000PF CER T.S.	CAPACITOR	1000 PF TEMP. STABLE CERAMIC CAPACITOR
C4	1	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C5	1	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C22,24,93	3	C TRIM 3.5-20PF	No description found in cross ref file	
C26,28-30,255	5	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C31-34	4	C 47UF 25V TAN	CAPACITOR	47 UF 25V TANTALUM CAPACITOR
CR1-38 Vot.	38	1N914	DIODE	SWITCHING DIODE
Q1	1	MPS2222	No description found in cross ref file	
R1,9-11,19-20,69, 78-79,131,140-141, 155,199,201,204, 206-208,223,240, 252-253,265,277-278 ok	26	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R2-4,6-8,12-14, 16-18,43,46,52, 70-72,75-77,142-144, 151-153,191,193,196, 198,209-211,218-220, 232,238-239,244, 250-251,257,263-264, 269,275-276 ok	49	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R5,15,73-74,230,235, 242,247,255,260,267, 272 ok	12	R 27K OHM 1/4W 2%	No description found in cross ref file	
R21-22,86-88, 134-136,139,149,159, 161,216,225,229,241, 254,266	18	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R23,80-85,125-130, 132-133,146,148,150, 154,156-157,160,190, 200,202-203,205,213, 215,217,221,224,226, 233-234,236-237, 245-246,248-249, 258-259,261-262, 270-271,273-274 ok	49	R 5K OHM 1/4W 2%	No description found in cross ref file	
R24,33,58,65,97,99, 102,110,116,122,RA2 ok	11	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR

RU 23

C6 - 10uF TANT

C8, 14, 13 -
C12 .1

SEE
STUFF
LIST

R7

Changes to R64, R66, R184-187
Add 1-200K, 1-360K, 1-24Ω
Changes to R279, R191, 194, 193, 198, 50
Add 1-1uf
Change C7

Reference No's	Total	Part Name	Part Type	Description
R25,28,30,32,36,42, 47,167,180,RA1,66	10	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R26,38,168,170, 181-182,184,186	8	R 1.62K OHM 1/4W 1%	RESISTOR	1.62K OHM 1/4W 1% RESISTOR
R27,29,145,147,158, 163,174,189,192, 194-195,197,212,214, 222,231,243,256,268	19	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R31,39	2	R 390 OHM 1/4W 2%	No description found in cross ref file	
R34,45,60-61, 100-101,103-109, 111-115,117-121,123, RA3	25	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R35,282 ok Manque (3) (2-1)	2	R 3.32K OHM 1/4W 2%	RESISTOR	3.32K OHM 1/4W 2% RESISTOR
R37,41	2	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R44	1	R 825 OHM 1/4W 1%	RESISTOR	825 OHM 1/4W 1% RESISTOR
R49,51,~~64~~,179	4	R 75 OHM 1/4W 2%	RESISTOR	75 1/4W 2% RESISTOR
R50 R162, R173	1	R 681 OHM 1/4W 1%	RESISTOR	681 OHM 1/4W 1% RESISTOR
R53	1	R 10 OHM 1/4W 2%	RESISTOR	10 1/4W 2% RESISTOR
R54,57,63,67,89-90, 94,96,164-166, 171-172,175-178,183	18	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R55	1	R 1.4K OHM 1/4W 1%	RESISTOR	1.4K OHM 1/4W 1% RESISTOR
R56,59	2	R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR
~~R66~~,280	2	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R91	1	R 6.19K OHM 1/4W 1%	RESISTOR	6.19K OHM 1/4W 1% RESISTOR
R92,98	2	R 47 OHM 1/4W 2%	No description found in cross ref file	
R~~162~~,~~173~~,188	3	R 2K OHM 1/4W 2%	RESISTOR	2K OHM 1/4W 2% RESISTOR
R185,187	2	R 400 OHM 1/4W 2%	No description found in cross ref file	
R227-228	2	R 1 OHM 1/2W 1%	RESISTOR	1 OHM 1/2W 1% RESISTOR
R279	1	R 2.21K OHM 1/4W 2%	RESISTOR	2.21K 1/4W 2% RESISTOR
R281	1	R 5.62K OHM 1/4W 1%	RESISTOR	5.62K OHM 1/4W 1% RESISTOR

Change R66 to 475Ω 1/4W 1%

Change R162 + R173 to 681Ω 1/4W 1%

Reference No's	Total	Part Name	Part Type	Description
RP1	✓ 1	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
SW1	✓ 1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
U1-2,10-11,20,25,27,31-33,35,47,49,51,53	✓ 15	LF347	No description found in cross ref file	
U3	✓ 1	AD589KH	No description found in cross ref file	
U4	✓ 1	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U5	1	MC1595L	No description found in cross ref file	
U6-7,38-40,48,50,52,54	✓ 9	AH0134	IC	DUAL ANALOG SWITCH
U8	✓1	MPQ6002	TRAN ARRAY	COMPLIMENTARY TRANSISTOR ARRAY
U9,15,17-19,29-30	✓ 7	3046	No description found in cross ref file	
U12-14,21-24,26,28,34,36-37	12	AD533JH	IC	ANALOG MULTIPLIER
U16	✓1	3054	No description found in cross ref file	
U41	✓1	74LS02	IC	QUAD 2-INPUT NOR GATE
U42	✓1	74LS04	IC	HEX INVERTER
U43	✓1	74LS377	IC	OCTAL REGISTER WITH ENABLE
U44-46	3	AD390	No description found in cross ref file	
U55-56,61	✓3	74LS240	IC	OCTAL BUS DRIVER
U57	✓1	74LS260	IC	DUAL 5-INPUT NOR GATE
U58	✓1	74LS175	IC	QUAD REGISTER W/CLEAR
U59	✓1	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U60,62	✓2	74LS138	IC	3-TO-8 LINE DECODER
U63-64	✓2	25LS2521	IC	8 BIT COMPARATOR
VR1	✓1	7805	No description found in cross ref file	
VR2	✓1	7905	No description found in cross ref file	

Reference No's	Part Name	Part Type	Description
U20	LF347	No description found in cross ref file	
U21-24	AD533JH	IC	ANALOG MULTIPLIER
U25	LF347	No description found in cross ref file	
U26	AD533JH	IC	ANALOG MULTIPLIER
U27	LF347	No description found in cross ref file	
U28	AD533JH	IC	ANALOG MULTIPLIER
U29-30	3046	No description found in cross ref file	
U31-33	LF347	No description found in cross ref file	
U34	AD533JH	IC	ANALOG MULTIPLIER
U35	LF347	No description found in cross ref file	
U36-37	AD533JH	IC	ANALOG MULTIPLIER
U38-40	AH0134	IC	DUAL ANALOG SWITCH
U41	74LS02	IC	QUAD 2-INPUT NOR GATE
U42	74LS04	IC	HEX INVERTER
U43	74LS377	IC	OCTAL REGISTER WITH ENABLE
U44-46	AD390	No description found in cross ref file	
U47	LF347	No description found in cross ref file	
U48	AH0134	IC	DUAL ANALOG SWITCH
U49	LF347	No description found in cross ref file	
U50	AH0134	IC	DUAL ANALOG SWITCH
U51	LF347	No description found in cross ref file	
U52	AH0134	IC	DUAL ANALOG SWITCH
U53	LF347	No description found in cross ref file	
U54	AH0134	IC	DUAL ANALOG SWITCH
U55-56	74LS240	IC	OCTAL BUS DRIVER
U57	74LS260	IC	DUAL 5-INPUT NOR GATE
U58	74LS175	IC	QUAD REGISTER W/CLEAR
U59	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U60	74LS138	IC	3-TO-8 LINE DECODER
U61	74LS240	IC	OCTAL BUS DRIVER
U62	74LS138	IC	3-TO-8 LINE DECODER
U63-64	25LS2521	IC	8 BIT COMPARATOR
VR1	7805	No description found in cross ref file	
VR2	7905	No description found in cross ref file	

Stuffing List for VID100A VID

Reference No's	Part Name	Part Type	Description
C1-2	C 1000PF CER T. S.	CAPACITOR	1000 PF TEMP. STABLE CERAMIC CAPACITOR
C3 TRIM	Reference not found in component list		
C4	C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR
C5	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C6 100pf	Reference not found in component list		
C7 220pf	~~Reference not found in component list~~		
C8	Reference not found in component list		
C9	Reference not found in component list		
C10-11	C 1000PF CER T. S.	CAPACITOR	1000 PF TEMP. STABLE CERAMIC CAPACITOR
C12 .1	Reference not found in component list		
C13	Reference not found in component list		
C14	Reference not found in component list		
C15 .1	Reference not found in component list		
C16 .1	Reference not found in component list		
C17	Reference not found in component list		
C18	Reference not found in component list		
C19	Reference not found in component list		
C20	Reference not found in component list		
C21 .1	Reference not found in component list		
C22	C TRIM 3.5-20PF	No description found in cross ref file	
C23 .1	Reference not found in component list		
C24	C TRIM 3.5-20PF	No description found in cross ref file	
C25 1UF	Reference not found in component list		
C26	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C27	Reference not found in component list		
C28-30	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C31-34	C 47UF 25V TAN	CAPACITOR	47 UF 25V TANTALUM CAPACITOR
C35 .1	Reference not found in component list		
C36 .1	Reference not found in component list		
C37 .1	Reference not found in component list		
C38 .1	Reference not found in component list		
C39 .1	Reference not found in component list		
C40 .1	Reference not found in component list		
C41 .1	Reference not found in component list		
C42 .1	Reference not found in component list		
C43 .1	Reference not found in component list		
C44 .1	Reference not found in component list		
C45 .1	Reference not found in component list		
C46 .1	Reference not found in component list		
C47 .1	Reference not found in component list		
C48 .1	Reference not found in component list		
C49 .1	Reference not found in component list		
C50 .1	Reference not found in component list		
C51 .1	Reference not found in component list		
C52 .1	Reference not found in component list		
C53	Reference not found in component list		
C54	Reference not found in component list		
C55 .1	Reference not found in component list		
C56 .1	Reference not found in component list		
C57	Reference not found in component list		
C58	Reference not found in component list		
C59	Reference not found in component list		
C60	Reference not found in component list		

RV23 - 1KΩ

RV33 - 5KΩ

RV48 - 200Ω

C7 changed to 220pf cer.
Add 1- 1uf 25V Tan.

D1V

Reference No's	Part Name	Part Type	Description
C61	Reference not found in component list		
C62	Reference not found in component list		
C63	Reference not found in component list		
C64	Reference not found in component list		
C65	Reference not found in component list		
C66	Reference not found in component list		
C67	Reference not found in component list		
C68	Reference not found in component list		
C69	Reference not found in component list		
C70	Reference not found in component list		
C71	Reference not found in component list		
C72	Reference not found in component list		
C73	Reference not found in component list		
C74	Reference not found in component list		
C75	Reference not found in component list		
C76	Reference not found in component list		
C77	Reference not found in component list		
C78	Reference not found in component list		
C79	Reference not found in component list		
C80	Reference not found in component list		
C81	Reference not found in component list		
C82	Reference not found in component list		
C83	Reference not found in component list		
C84	Reference not found in component list		
C85	Reference not found in component list		
C86	Reference not found in component list		
C87	Reference not found in component list		
C88	Reference not found in component list		
C89	Reference not found in component list		
C90	Reference not found in component list		
C91	Reference not found in component list		
C92	Reference not found in component list		
C93	C TRIM 3.5-20PF		No description found in cross ref file
C94	Reference not found in component list		
C95	Reference not found in component list		
C96	Reference not found in component list		
C97	Reference not found in component list		
C98	Reference not found in component list		
C99	Reference not found in component list		
C100	Reference not found in component list		
C101	Reference not found in component list		
C102	Reference not found in component list		
C103	Reference not found in component list		
C104	Reference not found in component list		
C105	Reference not found in component list		
C106	Reference not found in component list		
C107	Reference not found in component list		
C108	Reference not found in component list		
C109	Reference not found in component list		
C110	Reference not found in component list		
C111	Reference not found in component list		
C112	Reference not found in component list		
C113	Reference not found in component list		

Stuffing List for VID100A

Reference No's	Part Name	Part Type	Description
C114	Reference not found in component list		
C115	Reference not found in component list		
C116	Reference not found in component list		
C117	Reference not found in component list		
C118	Reference not found in component list		
C119	Reference not found in component list		
C120	Reference not found in component list		
C121	Reference not found in component list		
C122	Reference not found in component list		
C123	Reference not found in component list		
C124	Reference not found in component list		
C125	Reference not found in component list		
C126	Reference not found in component list		
C127	Reference not found in component list		
C128	Reference not found in component list		
C129	Reference not found in component list		
C130	Reference not found in component list		
C131	Reference not found in component list		
C132	Reference not found in component list		
C133	Reference not found in component list		
C134	Reference not found in component list		
C135	Reference not found in component list		
C136	Reference not found in component list		
C137	Reference not found in component list		
C138	Reference not found in component list		
C139	Reference not found in component list		
C140	Reference not found in component list		
C141	Reference not found in component list		
C142	Reference not found in component list		
C143	Reference not found in component list		
C144	Reference not found in component list		
C145	Reference not found in component list		
C146	Reference not found in component list		
C147	Reference not found in component list		
C148	Reference not found in component list		
C149	Reference not found in component list		
C150	Reference not found in component list		
C151	Reference not found in component list		
C152	Reference not found in component list		
C153	Reference not found in component list		
C154	Reference not found in component list		
C155	Reference not found in component list		
C156	Reference not found in component list		
C157	Reference not found in component list		
C158	Reference not found in component list		
C159	Reference not found in component list		
C160	Reference not found in component list		
C161	Reference not found in component list		
C162	Reference not found in component list		
C163	Reference not found in component list		
C164	Reference not found in component list		
C165	Reference not found in component list		
C166	Reference not found in component list		

Reference No's	Part Name	Part Type	Description
C167	Reference not found in component list		
C168	Reference not found in component list		
C169	Reference not found in component list		
C170	Reference not found in component list		
C171	Reference not found in component list		
C172	Reference not found in component list		
C173	Reference not found in component list		
C174	Reference not found in component list		
C175	Reference not found in component list		
C176	Reference not found in component list		
C177	Reference not found in component list		
C178	Reference not found in component list		
C179	Reference not found in component list		
C180	Reference not found in component list		
C181	Reference not found in component list		
C182	Reference not found in component list		
C183	Reference not found in component list		
C184	Reference not found in component list		
C185	Reference not found in component list		
C186	Reference not found in component list		
C187	Reference not found in component list		
C188	Reference not found in component list		
C189	Reference not found in component list		
C190	Reference not found in component list		
C191	Reference not found in component list		
C192	Reference not found in component list		
C193	Reference not found in component list		
C194	Reference not found in component list		
C195	Reference not found in component list		
C196	Reference not found in component list		
C197	Reference not found in component list		
C198	Reference not found in component list		
C199	Reference not found in component list		
C200	Reference not found in component list		
C201	Reference not found in component list		
C202	Reference not found in component list		
C203	Reference not found in component list		
C204	Reference not found in component list		
C205	Reference not found in component list		
C206	Reference not found in component list		
C207	Reference not found in component list		
C208	Reference not found in component list		
C209	Reference not found in component list		
C210	Reference not found in component list		
C211	Reference not found in component list		
C212	Reference not found in component list		
C213	Reference not found in component list		
C214	Reference not found in component list		
C215	Reference not found in component list		
C216	Reference not found in component list		
C217	Reference not found in component list		
C218	Reference not found in component list		
C219	Reference not found in component list		

Reference No's	Part Name	Part Type	Description
C220	Reference not found in component list		
C221	Reference not found in component list		
C222	Reference not found in component list		
C223	Reference not found in component list		
C224	Reference not found in component list		
C225	Reference not found in component list		
C226	Reference not found in component list		
C227	Reference not found in component list		
C228	Reference not found in component list		
C229	Reference not found in component list		
C230	Reference not found in component list		
C231	Reference not found in component list		
C232	Reference not found in component list		
C233	Reference not found in component list		
C234	Reference not found in component list		
C235	Reference not found in component list		
C236	Reference not found in component list		
C237	Reference not found in component list		
C238	Reference not found in component list		
C239	Reference not found in component list		
C240	Reference not found in component list		
C241	Reference not found in component list		
C242	Reference not found in component list		
C243	Reference not found in component list		
C244	Reference not found in component list		
C245	Reference not found in component list		
C246	Reference not found in component list		
C247	Reference not found in component list		
C248	Reference not found in component list		
C249	Reference not found in component list		
C250	Reference not found in component list		
C251	Reference not found in component list		
C252	Reference not found in component list		
C253	Reference not found in component list		
C254	Reference not found in component list		
C255	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
CR1-38	1N914	DIODE	SWITCHING DIODE
Q1	MPS2222	No description found in cross ref file	
R1	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R2-4	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R5	R 27K OHM 1/4W 2%	No description found in cross ref file	
R6-8	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R9-11	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R12-14	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R15	R 27K OHM 1/4W 2%	No description found in cross ref file	
R16-18	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R19-20	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR

Reference No's	Part Name	Part Type	Description
R21-22	RV MFT /104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R23	R 5K OHM 1/4W 2%	No description found in cross ref file	
R24	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R25	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R26	R 1.62K OHM 1/4W 1%	RESISTOR	1.62K OHM 1/4W 1% RESISTOR
R27	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R28	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R29	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R30	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R31	R 390 OHM 1/4W 2%	No description found in cross ref file	
R32	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R33	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R34	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R35	R 3.32K OHM 1/4W 2%	RESISTOR	3.32K OHM 1/4W 2% RESISTOR
R36	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R37	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R38	R 1.62K OHM 1/4W 1%	RESISTOR	1.62K OHM 1/4W 1% RESISTOR
R39	R 390 OHM 1/4W 2%	No description found in cross ref file	
R40 4.7K	Reference not found in component list		
R41	R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR
R42	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R43	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R44	R 825 OHM 1/4W 1%	RESISTOR	825 OHM 1/4W 1% RESISTOR
R45	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R46	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R47	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R48	Reference not found in component list		
R49	R 75 OHM 1/4W 2%	RESISTOR	75 1/4W 2% RESISTOR
R50 322Ω	~~R 681 OHM 1/4W 1%~~	~~RESISTOR~~	~~681 OHM 1/4W 1% RESISTOR~~
R51	R 75 OHM 1/4W 2%	RESISTOR	75 1/4W 2% RESISTOR
R52	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R53	R 10 OHM 1/4W 2%	RESISTOR	10 1/4W 2% RESISTOR
R54	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R55	R 1.4K OHM 1/4W 1%	RESISTOR	1.4K OHM 1/4W 1% RESISTOR
R56	R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR
R57	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R58 100Ω	R ~~2.74K~~ OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R59	R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR
R60-61	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R62 10K	Reference not found in component list		
R63	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R64 3.0Ω	~~R 75 OHM 1/4W 2%~~	~~RESISTOR~~	~~75 1/4W 2% RESISTOR~~
R65	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R66 475Ω	~~R 1.5K OHM 1/4W 1%~~	~~RESISTOR~~	~~1.5K OHM 1/4W 1% RESISTOR~~
R67	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R68	Reference not found in component list		
R69	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R70-72	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R73-74	R 27K OHM 1/4W 2%	No description found in cross ref file	
R75-77	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R78-79	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R80-85	R 5K OHM 1/4W 2%	No description found in cross ref file	
R86-88	RV MFT /104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K

Change R66 to 475Ω 1/4w 1%
Change R64 to 3.0Ω " "
Change R50

Reference No's	Part Name	Part Type	Description
R89-90	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R91	R 6.19K OHM 1/4W 1%	RESISTOR	6.19K OHM 1/4W 1% RESISTOR
R92	R 47 OHM 1/4W 2%	No description found in cross ref file	
R93 1.3K	Reference not found in component list		
R94	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R95	Reference not found in component list		
R96	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R97	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R98	R 47 OHM 1/4W 2%	No description found in cross ref file	
R99	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R100-101	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R102	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R103-109	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R110	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R111-115	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R116	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R117-121	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R122	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
R123	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
R124	Reference not found in component list		
R125-130	R 5K OHM 1/4W 2%	No description found in cross ref file	
R131	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R132-133	R 5K OHM 1/4W 2%	No description found in cross ref file	
R134-136	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R137	Reference not found in component list		
R138	Reference not found in component list		
R139	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R140-141	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R142-144	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R145	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R146	R 5K OHM 1/4W 2%	No description found in cross ref file	
R147	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R148	R 5K OHM 1/4W 2%	No description found in cross ref file	
R149	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R150	R 5K OHM 1/4W 2%	No description found in cross ref file	
R151-153	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R154	R 5K OHM 1/4W 2%	No description found in cross ref file	
R155	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R156-157	R 5K OHM 1/4W 2%	No description found in cross ref file	
R158	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R159	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R160	R 5K OHM 1/4W 2%	No description found in cross ref file	
R161	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R162	681Ω R ~~2K~~ OHM 1/4W 2%	RESISTOR	2K OHM 1/4W 2% RESISTOR
R163	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R164-166	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R167	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R168	R 1.62K OHM 1/4W 1%	RESISTOR	1.62K OHM 1/4W 1% RESISTOR
R169	Reference not found in component list		
R170	R 1.62K OHM 1/4W 1%	RESISTOR	1.62K OHM 1/4W 1% RESISTOR
R171-172	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R173	681Ω R ~~2K~~ OHM 1/4W 2%	RESISTOR	2K OHM 1/4W 2% RESISTOR
R174	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR

change R162 to 681Ω 1% 1/4W
change R123 ″

Stuffing List for VID100A

Reference No's	Part Name	Part Type	Description
R175-1/8	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R179	R 75 OHM 1/4W 2%	RESISTOR	75 1/4W 2% RESISTOR
R180	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
R181-182	R 1.62K OHM 1/4W 1%	RESISTOR	1.62K OHM 1/4W 1% RESISTOR
R183	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R184 2.0K	~~R 1.62K OHM 1/4W 1%~~	~~RESISTOR~~	~~1.62K OHM 1/4W 1% RESISTOR~~
R185 Jumper	~~R 400 OHM 1/4W 2%~~	~~No description found in cross ref file~~	
R186 2.0K	~~R 1.62K OHM 1/4W 1%~~	~~RESISTOR~~	~~1.62K OHM 1/4W 1% RESISTOR~~
R187 100Ω	~~R 400 OHM 1/4W 2%~~	~~No description found in cross ref file~~	
R188	R 2K OHM 1/4W 2%	RESISTOR	2K OHM 1/4W 2% RESISTOR
R189	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R190	R 5K OHM 1/4W 2%	No description found in cross ref file	
R191 20K	~~R 10K OHM 1/4W 2%~~	~~RESISTOR~~	~~10K 1/4W 2% RESISTOR~~
R192	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R193 20K	~~R 10K OHM 1/4W 2%~~	~~RESISTOR~~	~~10K 1/4W 2% RESISTOR~~
R194-195	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R196 20K	~~R 10K OHM 1/4W 2%~~	~~RESISTOR~~	~~10K 1/4W 2% RESISTOR~~
R197	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R198 20K	~~R 10K OHM 1/4W 2%~~	~~RESISTOR~~	~~10K 1/4W 2% RESISTOR~~
R199	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R200	R 5K OHM 1/4W 2%	No description found in cross ref file	
R201	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R202-203	R 5K OHM 1/4W 2%	No description found in cross ref file	
R204	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R205	R 5K OHM 1/4W 2%	No description found in cross ref file	
R206-208	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R209-211	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R212	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R213	R 5K OHM 1/4W 2%	No description found in cross ref file	
R214	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R215	R 5K OHM 1/4W 2%	No description found in cross ref file	
R216	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R217	R 5K OHM 1/4W 2%	No description found in cross ref file	
R218-220	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R221	R 5K OHM 1/4W 2%	No description found in cross ref file	
R222	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R223	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R224	R 5K OHM 1/4W 2%	No description found in cross ref file	
R225	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R226	R 5K OHM 1/4W 2%	No description found in cross ref file	
R227-228	R 1 OHM 1/2W 1%	RESISTOR	1 OHM 1/2W 1% RESISTOR
R229	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R230	R 27K OHM 1/4W 2%	No description found in cross ref file	
R231	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R232	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R233-234	R 5K OHM 1/4W 2%	No description found in cross ref file	
R235	R 27K OHM 1/4W 2%	No description found in cross ref file	
R236-237	R 5K OHM 1/4W 2%	No description found in cross ref file	
R238-239	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R240	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R241	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R242	R 27K OHM 1/4W 2%	No description found in cross ref file	
R243	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R284	R 200k ohm		
R287	R 340K ohm		

Change R184, 185, 186, 187
Change R191, 193, 196, 198

Reference No's	Part Name	Part Type	Description
R244	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R245-246	R 5K OHM 1/4W 2%	No description found in cross ref file	
R247	R 27K OHM 1/4W 2%	No description found in cross ref file	
R248-249	R 5K OHM 1/4W 2%	No description found in cross ref file	
R250-251	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R252-253	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R254	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R255	R 27K OHM 1/4W 2%	No description found in cross ref file	
R256	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R257	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R258-259	R 5K OHM 1/4W 2%	No description found in cross ref file	
R260	R 27K OHM 1/4W 2%	No description found in cross ref file	
R261-262	R 5K OHM 1/4W 2%	No description found in cross ref file	
R263-264	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R265	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R266	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R267	R 27K OHM 1/4W 2%	No description found in cross ref file	
R268	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R269	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R270-271	R 5K OHM 1/4W 2%	No description found in cross ref file	
R272	R 27K OHM 1/4W 2%	No description found in cross ref file	
R273-274	R 5K OHM 1/4W 2%	No description found in cross ref file	
R275-276	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R277-278	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R279 470Ω	~~R 2.21K OHM 1/4W 2%~~	~~RESISTOR~~	~~2.21K 1/4W 2% RESISTOR~~
R280	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R281	R 5.62K OHM 1/4W 1%	RESISTOR	5.62K OHM 1/4W 1% RESISTOR
R282	R 3.32K OHM 1/4W 2%	RESISTOR	3.32K OHM 1/4W 2% RESISTOR
R283 4.7K			
RA1	R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR
RA2	R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR
RA3	R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR
RP1	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
SW1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
U1-2	LF347	No description found in cross ref file	
U3	AD589KH	No description found in cross ref file	
U4	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U5	MC1595L	No description found in cross ref file	
U6-7	AH0134	IC	DUAL ANALOG SWITCH
U8	MPQ6002	TRAN ARRAY	COMPLIMENTARY TRANSISTOR ARRAY
U9	3046	No description found in cross ref file	
U10-11	LF347	No description found in cross ref file	
U12-14	AD533JH	IC	ANALOG MULTIPLIER
U15	3046	No description found in cross ref file	
U16	3054	No description found in cross ref file	
U17-19	3046	No description found in cross ref file	

Change R279

Unknown Parts for UID

R 40
62
93
RU 23, 33, 48 Burns 3006 - ? - ?
R283
C3 VARABLE TRIM
C6
C8
C14
C13
12
15 .1
16 .1
21 .1
23 .1
19 .1
20 .1
C 51 .1
52 .1
42 .1
43 .1
44 .1
45 .1
46 .1
47 .1
48 .1
49 .1
50 .1 uf

C 5
C 35
C 36 .1
38 .1
40 .1
C 53 .1 uf
54 .1
55 .1
56 .1
C18 .1
C17 .1
C 9 .1
C7 VARIABLE CAP
C37 .1
C39 .1
C41 .1

UID100A

BOARD ERRORS

U4 - MISSING A HOLE

TP11,12 - HOLE DIAMETER TOO SMALL

TP6?

R10 - GREEN MASK OVER HOLE

UID

Part missing

~~MPQ 2907 1 per board~~ ~~DAVE'S STOCK WILL COVER~~

MC1595L 1 per board

AD390 3 " "

VCB-2ØØA Addresses

12/30/83
DWS

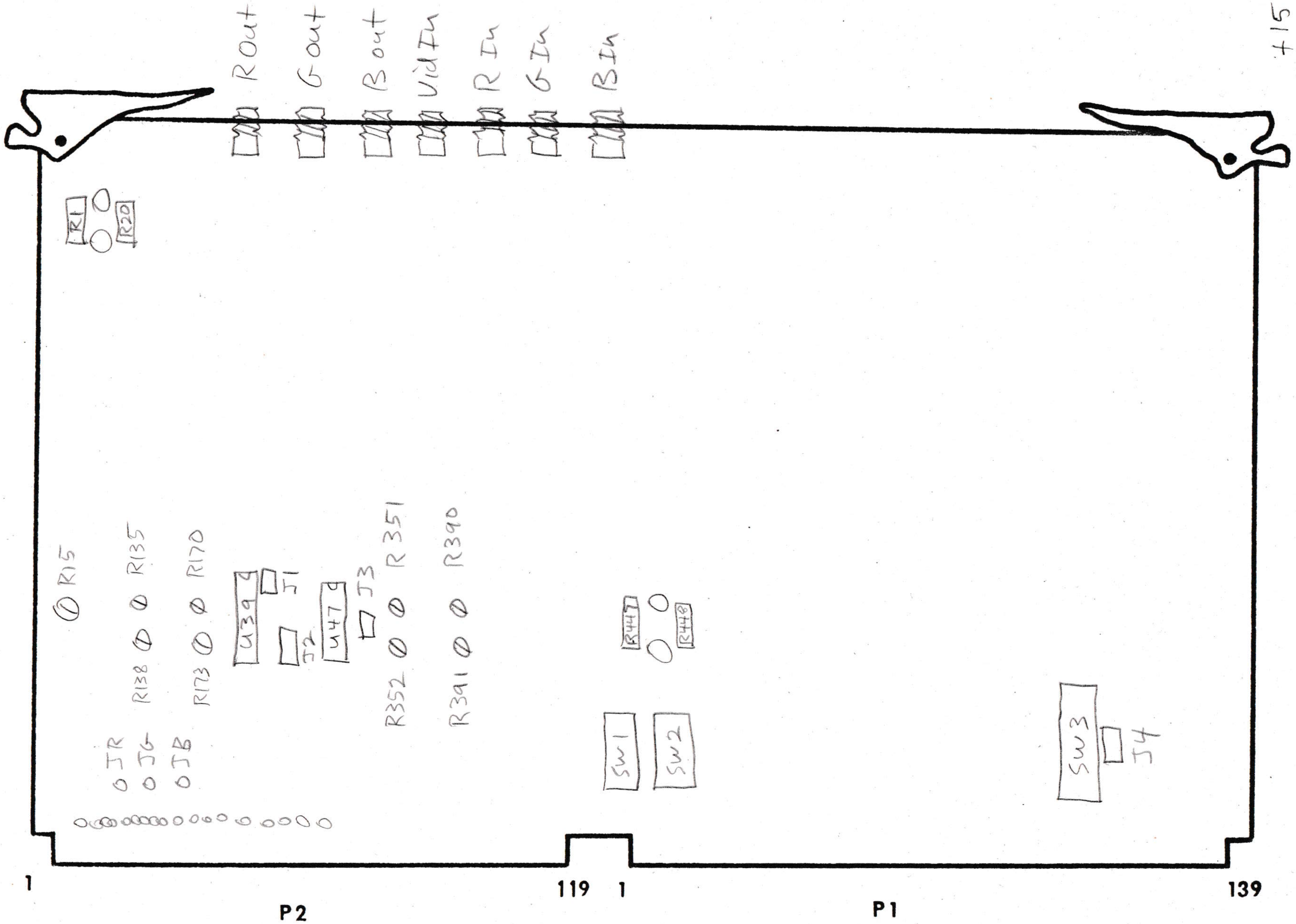
At each address is a 12-bit DAC.
Video In is clipped at LevA - LevD.
While video in is below LevA, the values R1, G1, B1, K1 appear at the Red, Green, Blue, and key outputs.
While video in is between LevA and LevB, the values R2, G2, B2, K2 appear at outputs.
This process is repeated thru video above LevD - resulting in R5, G5, B5, K5 at outputs.
Base Address DIP-sw 1 same format as VCB-1ØØ.
Map:

Base	LevA	Base +2Ø	R4
+2	LevB	+22	G4
+4	LevC	+24	B4
+6	LevD	+26	K4
+8	R1	+28	R5
+A	G1	+2A	G5
+C	B1	+2E	B5
+E	K1	+2E	K5
+1Ø	R2		
+12	G2		
+14	B2		
+16	K2		
+18	R3		
+1A	G3		
+1C	B3		
+1E	K3		

Only adjustments are gains for Red, Blue, Green, key outputs.
No bussing between VCB's as in -100A version. No ±5V supply requirements as in -100A version

BOARD UCB 101A VER. ____________

+15 -700 ma
-15 1 ma
+5 86 ma
-5 170 ma



Current cons.

+15V	671 ma
-15V	1 ma
+5V	86 ma
-5V	169 ma

$$\begin{array}{r} 777 \\ -106 \\ \hline 671 \end{array}$$

225

BASE ADDR 8-15
VALUES MUST BE IN DATA Ø-7
THIS BOARD CAN BE WRITTEN TO ANYTIME

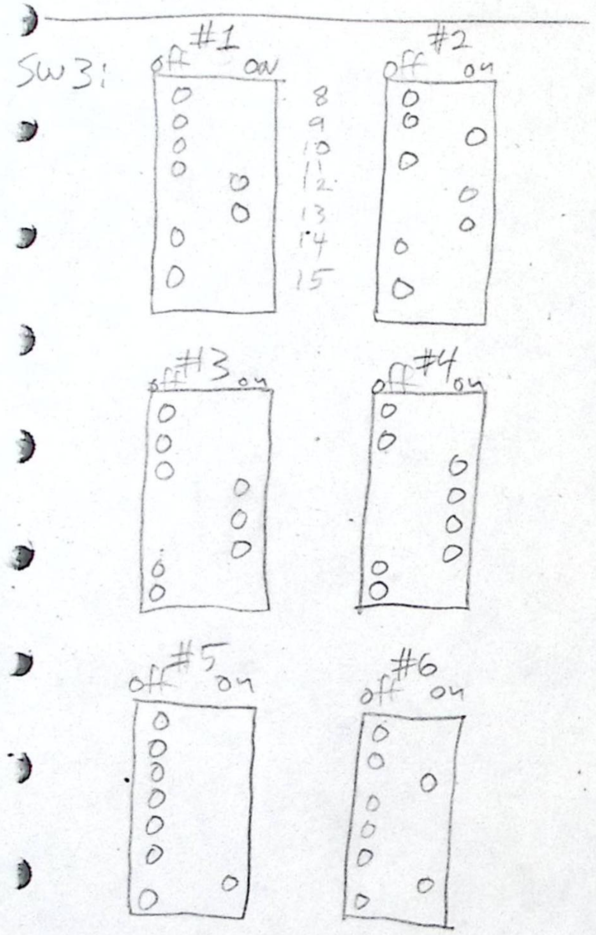
DTACK ≅ 125 N. SEC.

RESCAN CHANNEL: ALL PARAMETERS EFFECT THE ENTIRE RASTER.

FLYING SPOT CHANNEL: ALL PARAMETERS EFFECT THE ENTIRE RASTER.

Colorizer Addresses
1-FF3000
2-FF3400
3-FF3800
4-FF3C00
5-FF4000
6-FF4400

SW3:



Base +			OFFSET	7654321
20	RED BACKGROUND OFFSET		255 — 0	0010000
22	RED LEVEL 1 OFFSET		255 — 0	0010001
24	RED LEVEL 2 OFFSET		255 — 0	0010010
26	RED LEVEL 3 OFFSET		255 — 0	0010011
28	RED LEVEL 4 OFFSET		255 — 0	0010100
30	GREEN BACKGROUND OFFSET		255 — 0	0011000
32	GREEN LEVEL 1 OFFSET		255 — 0	0011001
34	GREEN LEVEL 2 OFFSET	00 white	255 — 0	0011010
36	GREEN LEVEL 3 OFFSET	FF Black	255 — 0	0011011
38	GREEN LEVEL 4 OFFSET		255 — 0	0011100
40	BLUE BACKGROUND OFFSET		255 — 0	0100000
42	BLUE LEVEL 1 OFFSET		255 — 0	0100001
44	BLUE LEVEL 2 OFFSET		255 — 0	0100010
46	BLUE LEVEL 3 OFFSET		255 — 0	0100011
48	BLUE LEVEL 4 OFFSET		255 — 0	0100100
50	RED BACKGROUND VIDEO AMPLITUDE		0 — 255	0101000
52	RED LEVEL 1 VIDEO AMPLITUDE		0 — 255	0101001
54	RED LEVEL 2 VIDEO AMPLITUDE		0 — 255	0101010
56	RED LEVEL 3 VIDEO AMPLITUDE		0 — 255	0101011
58	RED LEVEL 4 VIDEO AMPLITUDE		0 — 255	0101100
60	GREEN BACKGROUND VIDEO AMPLITUDE		0 — 255	0110001
62	GREEN LEVEL 1 VIDEO AMPLITUDE	00 off	0 — 255	
64	GREEN LEVEL 2 VIDEO AMPLITUDE	FF ON	0 — 255	
66	GREEN LEVEL 3 VIDEO AMPLITUDE		0 — 255	
68	GREEN LEVEL 4 VIDEO AMPLITUDE		0 — 255	
70	BLUE BACKGROUND VIDEO AMPLITUDE		0 — 255	01110000
72	BLUE LEVEL 1 VIDEO AMPLITUDE		0 — 255	
74	BLUE LEVEL 2 VIDEO AMPLITUDE		0 — 255	
76	BLUE LEVEL 3 VIDEO AMPLITUDE		0 — 255	
78	BLUE LEVEL 4 VIDEO AMPLITUDE		0 — 255	
00	LEVEL 1 ENCODE		0 — 255	0000000
02	LEVEL 2 ENCODE	Black 00, white FF	0 — 255	0000001
04	LEVEL 3 ENCODE		0 — 255	0000010
06	LEVEL 4 ENCODE		0 — 255	0000011
10	BACKGROUND PRIORITY		255 — 0	0001000
12	LEVEL 1 PRIORITY		255 — 0	0001001
14	LEVEL 2 PRIORITY	00 = MAX	255 — 0	0001010
16	LEVEL 3 PRIORITY	FF = MIN	255 — 0	0001011
18	LEVEL 4 PRIORITY		255 — 0	0001100

ADDRESSING
BITS

1-3	1 of 8 ROWS
4-6	1 of 8 COLUMNS
7-	UNUSED

CONTROL REGISTERS

BIT
0 - ENABLE VIDEO IN BACKGROUND
1 - ENABLE VIDEO IN LEVEL 1
2 - ENABLE VIDEO IN LEVEL 2
3 - ENABLE VIDEO IN LEVEL 3
4 - ENABLE VIDEO IN LEVEL 4

	REG1	REG2	REG3	REG4	REG5
COLORIZER 1 -	2	3	4	5	6
COLORIZER 2 -	1	3	4	5	6
COLORIZER 3 -	1	2	4	5	6
COLORIZER 4 -	1	2	3	5	6
COLORIZER 5 -	1	2	3	4	6
COLORIZER 6 -	1	2	3	4	5

BITS

			7 6 5 4 3 2 1
Base +	2A	REG 1	0 0 1 0 1 0 1
	3A	REG 2	0 0 1 1 1 0 1
	4A	REG 3	0 1 0 0 1 0 1
	5A	REG 4	0 1 0 1 1 0 1
	6A	REG 5	0 1 1 0 1 0 1

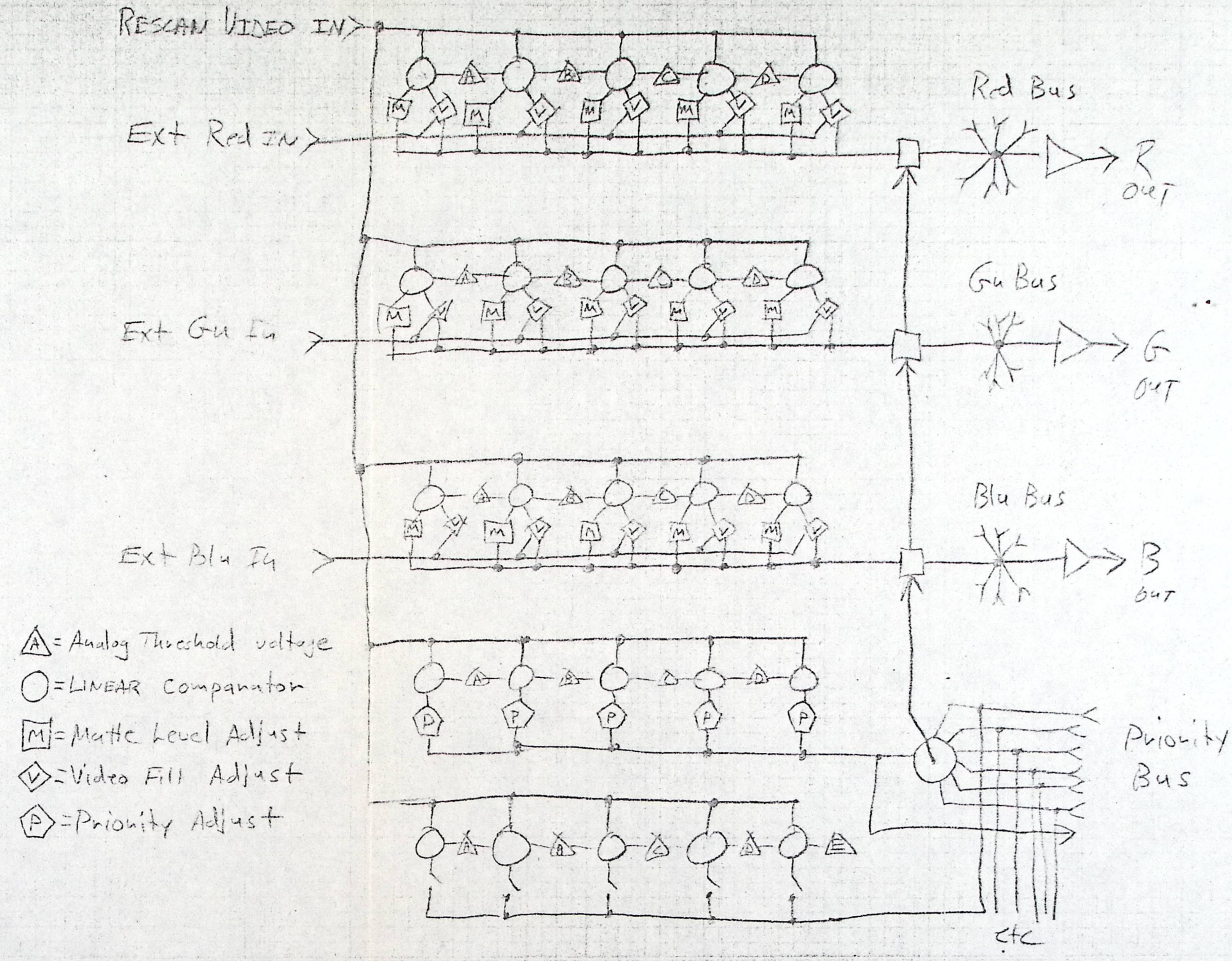
2A

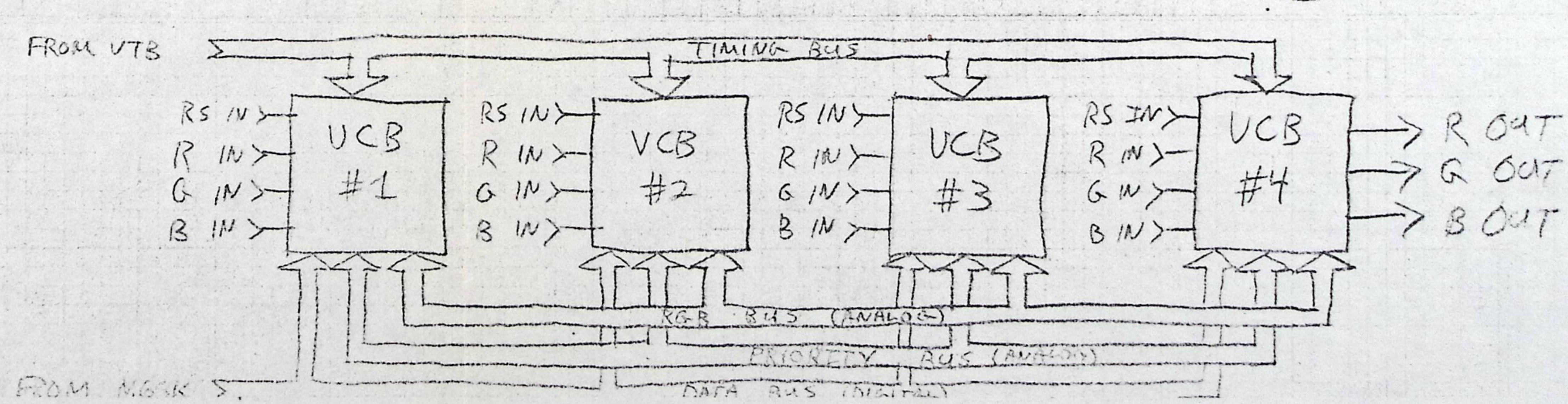
TABLE 2. J2/P2 Pin Assignments VCB-100 COLORIZER

ODD PIN NUMBER (P2 COMPONENT SIDE)	SIGNAL MNEMONIC	EVEN PIN NUMBER (P2 SOLDER SIDE)	SIGNAL MNEMONIC
1	GND	2	GND
3 Bussed	GND	4 Bussed	GND
5 only among	GND	6 among	GND
7 colorizers	+5V	8 colorizers	+5V
9 by 50pin	+5V	10 by wire-	+5V
11 ribbon.	+12V	12 wrap	+12V
13 every other	GND (± 15V)	14	GND (± 15V)
15 conductor	-12V	16	-12V
17 is GND	R1	18	
19	G1	20 R OUT	Rout
21	B1	22	
23	R2	24 G OUT	Gout
25	G2	26	
27	B2	28 B OUT	Bout
29	R3	30	
31	G3	32	
33	B3	34	
35	R4	36	
37	G4	38	
39	B4	40	
41	R5	42	
43	G5	44	
45	B5	46	
47	R6	48	
49	G6	50	
51	B6	52	
53	P1	54 +10 lgu	
55	P2	56	
57	P3	58 +5D gu	
59	P4	60	
61	P5	62 -5 y	
63	P6	64	
65		66	
67	-15V	68	-15V
69	+15V	70	+15V
71	~~+10~~	72	~~+10~~
73	~~+5D~~	74	~~+5D~~
75	~~-5~~	76	~~-5~~
77		78	
79		80	
81		82	
83		84	
85		86	
87		88	
89		90	
91		92	
93		94	
95		96	

TABLE 2. J2/P2 Pin Assignments

ODD PIN NUMBER (P2 COMPONENT SIDE)	SIGNAL MNEMONIC	EVEN PIN NUMBER (P2 SOLDER SIDE)	SIGNAL MNEMONIC
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND (± 15V)	14	GND (± 15V)
15	-12V	16	-12V
17		18	
19		20	
21		22	
23		24	
25		26	
27		28	
29		30	
31		32	
33		34	
35		36	
37		38	
39		40	
41		42	
43		44	
45		46	
47		48	
49		50	
51		52	
53		54	
55		56	
57		58	
59		60	
61		62	
63		64	
65		66	
67	-15V	68	-15V
69	+15V	70	+15V
71		72	
73		74	
75		76	
77		78	
79		80	
81		82	
83		84	
85		86	
87		88	
89		90	
91		92	
93		94	
95		96	


RESCAN VIDEO IN
Ext Red IN
Ext Gn In
Ext Blu In
Red Bus
R OUT
Gn Bus
G OUT
Blu Bus
B OUT
Priority Bus
etc
A = Analog Threshold voltage
O = LINEAR Comparator
M = Matte Level Adjust
V = Video Fill Adjust
P = Priority Adjust


FROM VTB
TIMING BUS
RS IN
R IN
G IN
B IN
VCB #1
VCB #2
VCB #3
VCB #4
R OUT
G OUT
B OUT
RGB BUS (ANALOG)
PRIORITY BUS (ANALOG)
DATA BUS (DIGITAL)

VCB-101A SETUP
(DO MODS FIRST, CK FOR SHORTS)

---INIT VTB WITH FF0000 = 00 AND FF0002 = 40.

POWER UP---
---USE REPEAT PROGRAM TO VERIFY DTACK TURN-AROUND.
---SET DATA AT FF012A TO 000.
---SCOPE PIN 2 OF U-73.
---VERIFY THAT CHANGING DATA TO FFF CAUSES LOW TO HIGH.

---LOAD RAMP PGM, ADDRESS AND CHECK FOR 0 TO +10 RAMP AT PIN 16 OF DAC AS FOLLOWS:

ADDRESS	DAC	
FF0100 (3)	U-75	ALSO CHECK FOR 2V RAMP +10 OFFSET U-71 PIN 7
FF0102	U-76	ALSO CHECK FOR 2V RAMP +5 OFFSET U-71 PIN 8
FF0104	U-77	ALSO CHECK FOR 2V RAMP +10 OFFSET U-72 PIN 7
FF0106	U-78	ALSO CHECK FOR 2V RAMP +5 OFFSET U-72 PIN 8
FF0110	U-81	
FF0112	U-82	
FF0114	U-83	
FF0116	U-84	
FF0118	U-85	
FF0120	U-100	
FF0122	U-101	
FF0124	U-102	
FF0126	U-103	
FF0128	U-104	
FF0130	U-93	
FF0132	U-94	
FF0134	U-95	
FF0136	U-96	
FF0138	U-97	
FF0140	U-86	
FF0142	U-87	
FF0144	U-88	
FF0146	U-89	
FF0148	U-90	
FF0150	U-105	
FF0152	U-106	
FF0154	U-107	
FF0156	U-108	
FF0158	U-109	
FF0160	U-112	

```
        FF0162    U-113
        FF0164    U-114
        FF0166    U-115
        FF0168    U-116
        ------------------------------------------------------------
        FF0170    U-120
        FF0172    U-121
        FF0174    U-122
        FF0176    U-123
        FF0178    U-124
        ------------------------------------------------------------


---APPLY A MONOCHROME STAIRSTEP SIGNAL TIMED TO HOUSE DRIVES
         CONNECTOR.


---AT FF0002 PUT 03.
        ---RETRIM VTB R27 IF CLAMP TIMING IS OFF. (SCOPE U-17 PIN 9, VIDEO WITH
          10V CLAMP, THEN U-17 PIN 5, VIDEO WITH 5V CLAMP.  VIDEO IN BOTH
          CASES SHOULD BE APPROX. 2V PP.)


POWER UP---
        ---PUT DIP CLIP ON U-9.
        ---PUT BOTH TRACES TO DC, 1V/CM, BOTH PROBES TO PIN 2.
        ---ADJUST SCOPE POSITIONS TO SUPERIMPOSE BOTH TRACES WITH BLANKING
           LEVEL AT CENTER GRATICULE.
        ---MOVE ONE PROBE TO PIN 4.
        ---AT FF0100 ENTER 00.  PIN 4 SIGNAL SHOULD GO TO BASELINE.
        ---AT FF0100 ENTER FF.  PIN 4 SIGNAL SHOULD GO ABOVE WHITE.
        ---MOVE CHIP CLIP AND BOTH PROBES TO U-11.
        ---AT FF0104 ENTER 00.  PIN 4 SHOULD GO TO BASELINE.
        ---ENTER FF; SHOULD GO ABOVE WHITE.
        ---MOVE CHIP CLIP TO U-10, SCOPE PROBES BOTH TO PIN 6.
        ---READJUST POSITIONS AS ABOVE.
        ---MOVE ONE PROBE TO PIN 9.
        ---AT FF0102 ENTER 00.  PIN 9 SIGNAL SHOULD GO TO BASELINE.  FF=+WHITE
        ---MOVE CLIP AND BOTH PROBES TO U-12.
        ---AT FF0106 ENTER 00.  CHECK BASE LINE, ENTER FF = +WHITE.
        ---NOTE:  IF IN ANY OF THE ABOVE TESTS, THE 00 CODE CAUSED THE TRACE
                  TO FALL ABOVE THE BASELINE, THE APPROPRIATE ZENER DIODE,
                  CR 62, 63, 64 OR 65, MUST BE REPLACED.
        ---ENTER THE FOLLOWING:
                   FF0100 = 20
                   FF0102 = 30
                   FF0104 = 60
                   FF0106 = 80
        ---SCOPE U-12 PIN 5, 1 TRACE.
        ---SET POSITION POT ON SCOPE FOR BASELINE = 0.


---AS THE FOLLOWING VALUES ARE ENTERED, CHECK FOR INDIVIDUAL STEP LEVEL
   CHANGES (NEGATIVE GOING, 00 = MAX, FF = MIN):

                   FF0120 : 00
                   FF0122 : 30
```

FF0124 : 60
FF0126 : 90
FF0128 : C0

---IF OK, MOVE CLIP TO U-21, DO SAME AT THESE ADDRESSES:

FF0130 : 00
FF0132 : 30
FF0134 : 60
FF0136 : 90
FF0138 : C0

---AND THESE (U-29 PIN 5):

FF0140 : 00
FF0142 : 30
FF0144 : 60
FF0146 : 90
FF0148 : C0

---CONNECT CROSSHATCH SIGNAL VIDEO TO "RED IN", SCOPE U-12 PIN 5. VERIFY NEG. GOING VIDEO GOES AWAY AS EACH LEVEL IS SET AT ZERO:

FF0150 : 00
FF0152 : 00
FF0154 : 00
FF0156 : 00
FF0158 : 00

---MOVE CROSSHATCH VIDEO TO "GREEN IN", SCOPE U-21 PIN 5 AS ABOVE:

FF0160 : 0
FF0162 : 0
FF0164 : 0
FF0166 : 0
FF0168 : 0

---MOVE TO "BLUE IN", SCOPE U-29 PIN 5 AS ABOVE:

FF0170 : 0
FF0172 : 0
FF0174 : 0
FF0176 : 0
FF0178 : 0

---SWR WIPE IN:

FF3000	2C	FF3010	7F	FF3020	FF
FF3002	22	FF3012	7F	FF3022	0
FF3004	79	FF3014	7F	FF3024	FF
FF3006	91	FF3016	7F	FF3026	FF

		FF3018	FF	FF3028	7F
				FF302A	0
FF3030	FF	FF3040	FF		
FF3032	FF	FF3042	FF		
FF3034	0	FF3044	FF		
FF3036	FF	FF3046	0		
FF3038	7F	FF3048	7F		
FF303A	0	FF304A	0		

FF3050 - FF307E = 0
2A - 7A = 0

FF3400	1B	FF3410	0	
FF3402	3B	FF3412	0	COLOR AS ABOVE
FF3404	7D	FF3414	A3	
FF3406	86	FF3416	0	
		FF3418	0	

FF342A = 10; ALL OTHERS = 0

--GRAY LEVEL STAIRSTEP IN.

Initialization Table for: VCB #1 TEST PGM L2

Base = FF3000

00	20	20	FF	40	FF	60	0	80	A0	C0	E0
02	40	22	0	42	FF	62		82	A2	C2	E2
04	60	24	FF	44	FF	64		84	A4	C4	E4
06	80	26	FF	46	0	66		86	A6	C6	E6
08		28	7F	48	7F	68		88	A8	C8	E8
0A		2A	0	4A	0	6A	0	8A	AA	CA	EA
0C		2C		4C		6C		8C	AC	CC	EC
0E		2E		4E		6E		8E	AE	CE	EE
10	0	30	FF	50	0	70	0	90	B0	D0	F0
12	0	32	FF	52		72		92	B2	D2	F2
14	0	34	0	54		74		94	B4	D4	F4
16	0	36	FF	56		76		96	B6	D6	F6
18	0	38	7F	58		78		98	B8	D8	F8
1A		3A	0	5A	0	7A	0	9A	BA	DA	FA
1C		3C		5C		7C		9C	BC	DC	FC
1E		3E		5E		7E		9E	BE	DE	FE

Base = FF3400 VCB#2

00	20	20	FF	40	FF	60	0	80	A0	C0	E0
02	40	22	0	42	FF	62		82	A2	C2	E2
04	60	24	FF	44	FF	64		84	A4	C4	E4
06	80	26	FF	46	0	66		86	A6	C6	E6
08		28	7F	48	7F	68		88	A8	C8	E8
0A		2A	0	4A	0	6A	0	8A	AA	CA	EA
0C		2C		4C		6C		8C	AC	CC	EC
0E		2E		4E		6E		8E	AE	CE	EE
10	FF	30	FF	50	0	70	0	90	B0	D0	F0
12	FF	32	FF	52		72		92	B2	D2	F2
14	FF	34	0	54		74		94	B4	D4	F4
16	FF	36	FF	56		76		96	B6	D6	F6
18	FF	38	7F	58		78		98	B8	D8	F8
1A		3A	0	5A	0	7A	0	9A	BA	DA	FA
1C		3C		5C		7C		9C	BC	DC	FC
1E		3E		5E		7E		9E	BE	DE	FE

Initialization Table for: VCB #3 TEST PGM L2

Base = FF3800

00	20	20	FF	40	FF	60	0	80	A0	C0	E0
02	40	22	0	42	FF	62		82	A2	C2	E2
04	60	24	FF	44	FF	64		84	A4	C4	E4
06	80	26	FF	46	0	66		86	A6	C6	E6
08		28	7F	48	7F	68		88	A8	C8	E8
0A		2A	0	4A	0	6A	0	8A	AA	CA	EA
0C		2C		4C		6C		8C	AC	CC	EC
0E		2E		4E		6E		8E	AE	CE	EE
10	FF	30	FF	50	0	70	0	90	B0	D0	F0
12	FF	32	FF	52		72		92	B2	D2	F2
14	FF	34	0	54		74		94	B4	D4	F4
16	FF	36	FF	56		76		96	B6	D6	F6
18	FF	38	7F	58		78		98	B8	D8	F8
1A		3A	0	5A	0	7A	0	9A	BA	DA	FA
1C		3C		5C		7C		9C	BC	DC	FC
1E		3E		5E		7E		9E	BE	DE	FE

Base = FF3C00 VCB #4

00	20	20	FF	40	FF	60	0	80	A0	C0	E0
02	40	22	0	42	FF	62		82	A2	C2	E2
04	60	24	FF	44	FF	64		84	A4	C4	E4
06	80	26	FF	46	0	66		86	A6	C6	E6
08		28	7F	48	7F	68		88	A8	C8	E8
0A		2A	0	4A	0	6A	0	8A	AA	CA	EA
0C		2C		4C		6C		8C	AC	CC	EC
0E		2E		4E		6E		8E	AE	CE	EE
10	FF	30	FF	50	0	70	0	90	B0	D0	F0
12	FF	32	FF	52		72		92	B2	D2	F2
14	FF	34	0	54		74		94	B4	D4	F4
16	FF	36	FF	56		76		96	B6	D6	F6
18		38	7F	58		78		98	B8	D8	F8
1A		3A	0	5A	0	7A	0	9A	BA	DA	FA
1C		3C		5C		7C		9C	BC	DC	FC
1E		3E		5E		7E		9E	BE	DE	FE

VCB-101A MODS

*PROBLEM: ADDRESS MODIFIER BITS INCORRECT.

SOLUTION: CUT 2 TRACES, ADD 2 JUMPERS:

```
 X = CUT                     | U-99 |
                             |______|
\                                       O    O
 J = ADD JUMPER                         |    |
  \                                     X    X   <---CUT
                                        |    |
      BEFORE:     __TT___TT___TT___TT___TT___TT___TT___TT___TT____
                                       81   83   85
             P1


                                         O     O
                                          \     \
                                           J     J    <---ADD
                                            \     \
      AFTER:      __TT___TT___TT___TT___TT___TT___TT___TT___TT____
                                        81   83   85
             P1
```

*PROBLEM: U-128 PULLUP RESISTORS OMITTED.

SOLUTION: ADD 2.2K 1/4W 5% FROM U-128 PIN 6 TO 14;
---ADD 1K 1/4W 5% FROM U-128 PIN 8 TO 14;
---ADD 1K 1/4W 5% FROM U-128 PIN 11 TO 14, AS SHOWN:

```
                      |----------|
              _____   |          |              U-128
              |   |--14---|      |   1
              |1K |       |      |              REAR
              |   |  O    |    __|__ O
              |   |     __|__  |   |
              |___|  O  |   |  |2.2| O
                |       |1K |  | K |
                |----11 |   |  |   | O
                        |   |  |___|
                     O  |___|    |   O
                          |      |
                     O    |      |---6
                          |
                     8----|          7
```

*PROBLEM: INADEQUATE BIAS, R, G, B, INPUT AMPS.

SOLUTION: REPLACE R285, 416, 399 WITH 910 ohms 1/4W 5%.

*PROBLEM: RGB INPUTS DRIFT DURING VERT INT.

SOLUTION: REMOVE R267, 361, 376.

*PROBLEM: RGB INPUTS NOT TERMINATED.

SOLUTION: ADD 75 ohm RESISTORS, BACK OF RGB INPUT CONNECTORS:

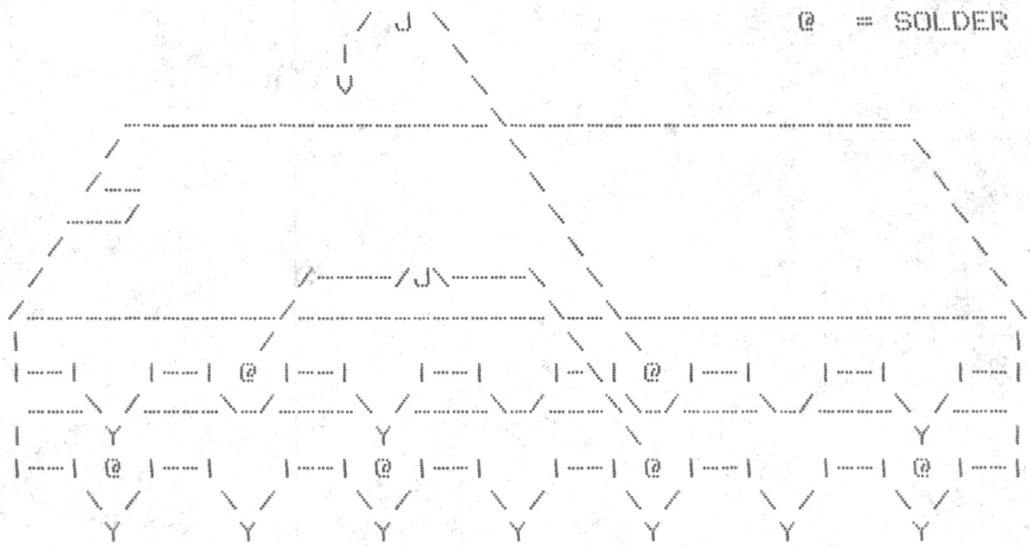
```
                  [ ]         [ ]

          |-----------|
        /|  75ohms  |-----O              COMP SIDE
       |  |-----------|
       |
        \-----------[ ]         [ ]

----------------------------      --------------------------
                          |---------|        BOARD EDGE
```

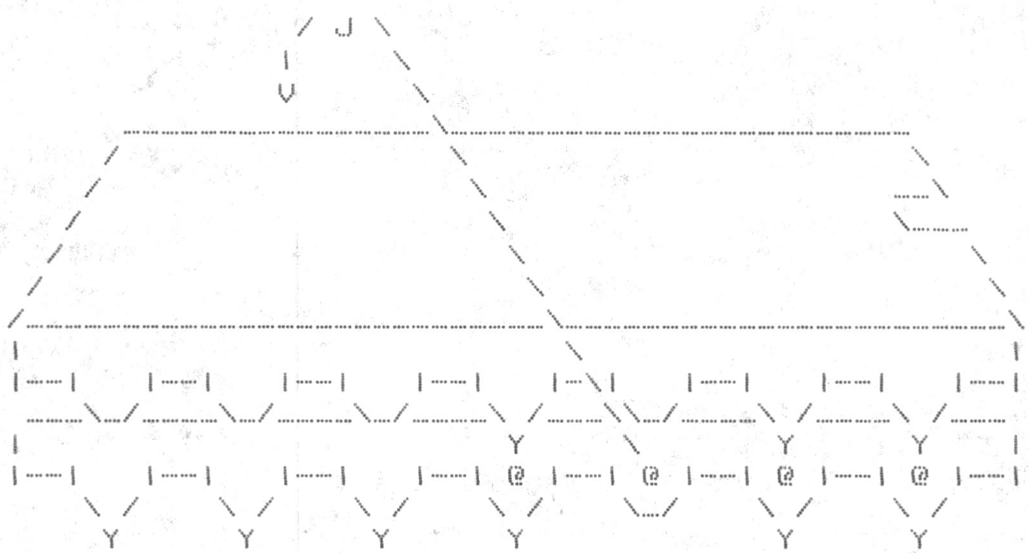
*PROBLEM: ADDRESS SELECT TIME TOO SHORT FOR DAC'S.

SOLUTION: 74S74 PIGGYBACK FOR U-125:
- --STACK TWO 74S74'S ONE ON TOP OF THE OTHER (BE SURE INDEXES MATCH).
- --SOLDER THE TOP PINS TO THE BOTTOM FOR THESE PINS ONLY: 1, 3, 7, 11, 13, 14.
- --CUT THE PIN PART OF THE LEG OFF FOR THE TOP CHIP'S PINS 2, 4, 5, 6, 8, 9, 10, 12.
- --CUT THE PIN PART OF THE BOTTOM CHIP'S LEG AT PIN 12.
- --SOLDER A WIREWRAP WIRE JUMPER FROM THE BOTTOM CHIP'S PIN 5 TO THE TOP CHIP'S PIN 2.
- --SOLDER A WIREWRAP WIRE JUMPER FROM THE TOP CHIP'S PIN 5 TO THE BOTTOM CHIP'S PIN 12.

/J\ = ADD JUMPER

@ = SOLDER





*PROBLEM: + AND - 15 TRACES LEFT OFF, U-33.

SOLUTION: JUMPER U-33 PIN 11 TO U-16 PIN 11, AND U-33 PIN 12 TO U-16 PIN 12.

*PROBLEM: RESISTOR VALUE CHANGE.

SOLUTION: REMOVE 15K ohms: R83, 88, 92, 96, 100, 149, 154, 158, 162, 166,
211, 216, 220, 224, 228.
---REPLACE WITH 6.81K 1/4W 1%.

REMOVE 6.8K: R82, 87, 91, 95, 99, 148, 153, 157, 161, 165,
210, 215, 219, 223, 227.
---REPLACE WITH 3.32K 1/4W 1%.

REMOVE 430 ohms: R71, 107, 106, 141, 175, 174, 200, 238, 237, 263,
282, 281, 305, 330, 329, 357, 396, 395.
---REPLACE WITH 200 ohms 1/4W 1%.

REMOVE 56pf: C17, 22, 21, 23, 26, 25, 27, 32, 31, 33, 38, 37, 39,
42, 41, 43, 47, 46.
---REPLACE WITH 220pf.

*PROBLEM: BOARD CAPACITANCE AFFECTS HIGH FREQUENCY RESPONSE.

SOLUTION: BUS TERMINATORS (SEE SCHEMATIC ADDENDUM).

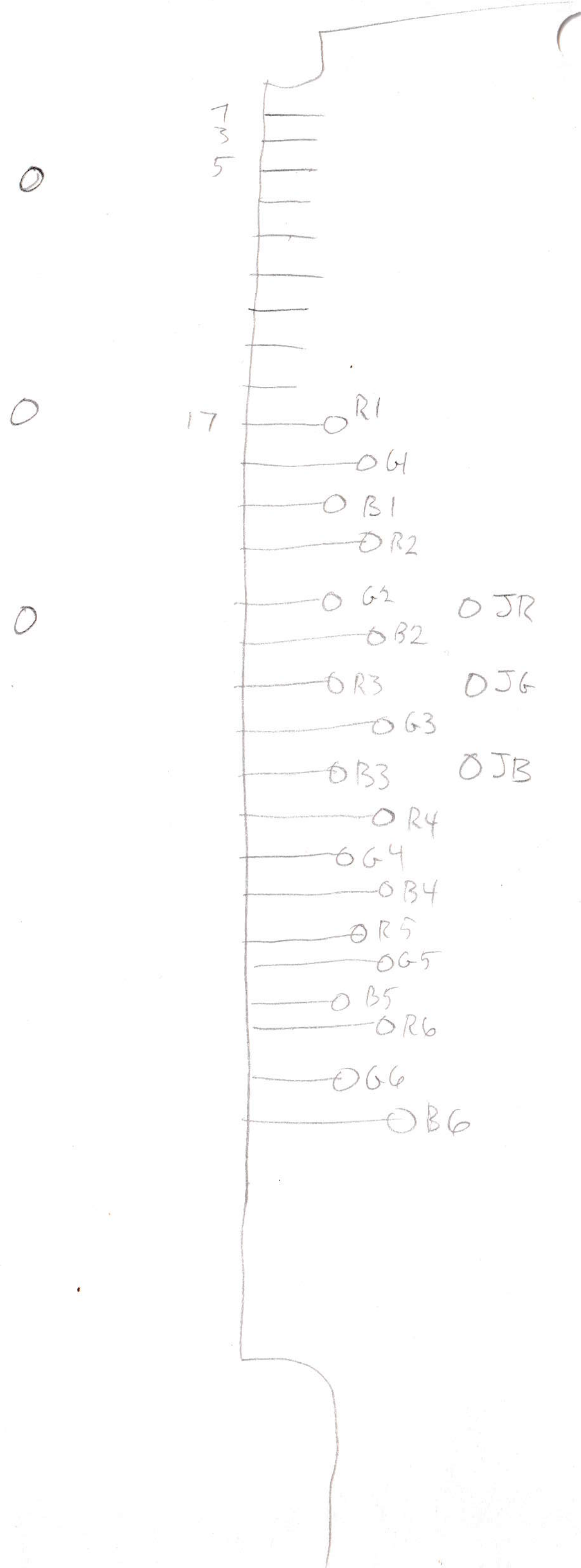
Colorizer, Channel 1
Jumper JR to R1, JG to G1, JB to B1
Jumper SW1 pins 14 + 1, 2+13, 3+12, 4+11,
5+10, 6+9
Jumper SW2 pin 1+14, 2+13, 3+12, 4+11, 5+10, 6+9

Colorizer Channel 2
Jumper JR to R2, JG to G2, JB to B2
Jumper SW1 pins 1 to 13, 2 to 14, 3 to 12, 4 to 11
Jumper SW2 pins 1 +13, 2+14, 3+12, 4+11

Colorizer Channel 3
Jumper JR to R3, JG to G3, JB to B3
Jumper SW1 pins 1 +12, 2 + 14, 3+13, 4 to 11
Jumper SW2 pins 1 +12, 2+ 14, 3+13, 4+11

Colorizer Channel 4
Jumper JR to R4, JG to G4, JB to B4
Jumper SW1 pins 1 + 11, 2+14, 3+13, 4+12
Jumper SW2 pins 1 + 11, 2+14, 3+13, 4+12

✓ (put at end of VCB101A.FX 5/12


1
3
5
17
R1
G1
B1
R2
G2
B2
R3
G3
B3
R4
G4
B4
R5
G5
B5
R6
G6
B6
JR
JG
JB

user 1101 UCB101A.DC

1

UCB-101A Setup
(do mods first, ck for shorts)
Init VTB with FF0000 = 00
and FF0002 = 40

Pwr up, check for hot tantalums.
Pwr off, install U74, 80, 126 (74LS240).
install U 111, 119 (25LS2521)
install U92, 99 (74LS138)
install U-125 (74S74)
" U128 (74S38 special)
" U117, 118 (7428)
" U73, 79, 91, 98, 110 (74LS377)
Set SW3 ~~all off except #1~~ by chart
Install U 127 (74260)
PWR on — Use repeat program to verify DTACK turn-around. Set data at FF012A to 000 scope pin 2 of U-73. Verify that changing data to FFF causes low to high.
PWR off — Install U-75, 81, 86, 93, 100, 105, 112, 120,
76, 82, 87, 94, 101, 106, 113, 121,
77, 83, 88, 95, 102, 107, 114, 122
78, 84, 89, 96, 103, 108, 115, 123
85, 90, 97, 104, 109, 116, 124
Pwr On, Load ramp pgm, Address and check for 0 to +10 Ramp at pin 16 of Dacs as follows:
Install U71, 72 (MPQ2483)

Setup 2

Address	DAC	
FF0100	U75	also check for 2v Ramp +10 offset → U71 pin 7
FF0102	U76	" 2v Ramp +5v offset U71 pin 8
104	77	" 2v Ramp +10 offset U72 p 7
106	78	2v +5v offset U72 p 8
110	81	
112	82	
114	83	
116	84	
118	85	
120	100	
122	101	
124	102	
126	103	
128	104	
130	93	
132	94	
134	95	
136	96	
138	97	
140	86	
142	87	
144	88	
146	89	
148	90	
150	105	
152	106	
154	107	
156	108	
158	109	

Setup 3

Address	
FF0160	112
162	113
164	114
166	115
168	116
170	120
172	121
174	122
176	123
178	124

Pwr off —

~~Install U71 +72, (MPQ 2483)~~

Install U 8 +17 (CA3046)

Install U 16 (AH0134)

Apply a monochrome stairstep signal timed to house drives to "Video In" connector.

Pwr on — at FF0002 put 03. Retrim UTB R27 if clamp timing is off. (Scope U17 pin 9, video with 10v clamp, then U17 pin 5, video with 5v clamp. Video in both cases should be ≈ 2v pp.

Pwr off, install U 9, 10, 11, 12, 13, 18, 19, 20, 21, 22, 26, 27, 28, 29, 30 (CA3046)

Install U 6, 7, 23, 31, 55, 63 (MPQ 2907)

Setup 4

Pwr up, put chip clip on U9, put both traces to DC, 1v/cm, both probes to pin 2. Adjust scope positions to superimpose both traces with blanking level at center graticule. move one probe to pin 4. At FF0100 enter 00. Pin 4 signal should go to baseline, At FF0100 enter FF. Pin 4 signal should go above white. Move chip clip and both probes to U-11. at FF0104 enter 00, Pin 4 should go to baseline, enter FF, should go above white.
Move chip clip to U-10, scope probes both to pin 6. Re adjust positions as above. move one probe to pin 9. At FF0102 enter 00, pin 9 signal should go to baseline, FF=+white
Move clip and both probes to U12. At FF0106 enter 00 check base line, enter FF = + white.

Note: If in any of the above tests, the 00 code caused the trace to fall above the baseline, the appropriate zener diode, CR62, 63, 64 or 65 must be replaced.

Enter the following: FF0100=20
FF0102=30 FF0104=60
FF0106=80. Scope U12 pin 5, 1 trace, set position pot on scope for baseline=0. as the following values are entered, check for individual step level changes (negative going, 00=max, FF=min)

Setup

FF0120 : 00 FF0122 : 30
FF0124 : 60 FF0126 : 90
FF0128 : C0

If ok, move clip to U21, do same at these addresses:

FF0130 : 00 FF0132 30
FF0134 : 60 FF0136 90
FF0138 : C0

and these: (U29 pin 5

FF 0140 : 00 FF0142 : 30
FF 0144 : 60 FF0146 : 90
FF0148 : C0

Connect crosshatch signal video to "Red In", scope pin 5 U12. verify neg. going video goes away as each level is set at zero.

FF0150 : 00, FF0152 = 00
FF0154 : 00 FF0156 = 00
FF0158 : 00

Move crosshatch Video to "Green In" scope U21 p 5 as above
0 = FF0160, FF0162, FF0164, FF0166, FF0168
Move to "Blue In" scope U29 p 5 as above
0 = FF0170, FF0172, FF0174, FF0176, FF0178

SWR WIPE IN

3018-FF

70 3000	2C	3010-67F		
59 2	22	3020 FF	3030 FF	3040 FF
135 4	79	2 0	2 FF	2 FF
6	91	4 FF	4 0	4 FF
		6 FF	6 FF	6 0
		8 7F	8 7F	8 7F
		A 00	A 0	A 0

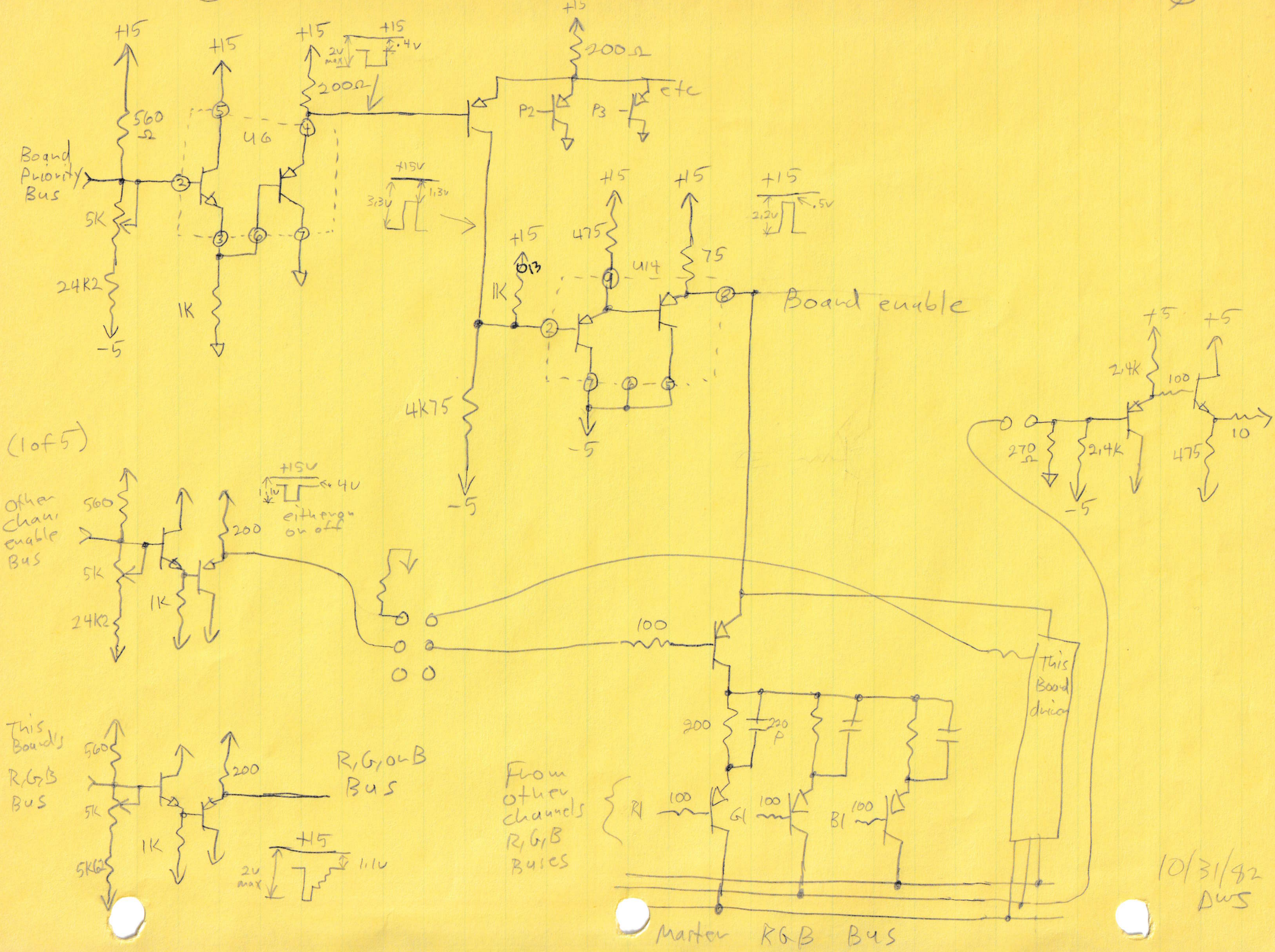
3050-307E-0 2A-7A=0

3400	1B	3410-0	color as above
2	3B	12 0	
4	7D	4 A3	
6	86	6 0	
		8 0	

2A=10 all others 0

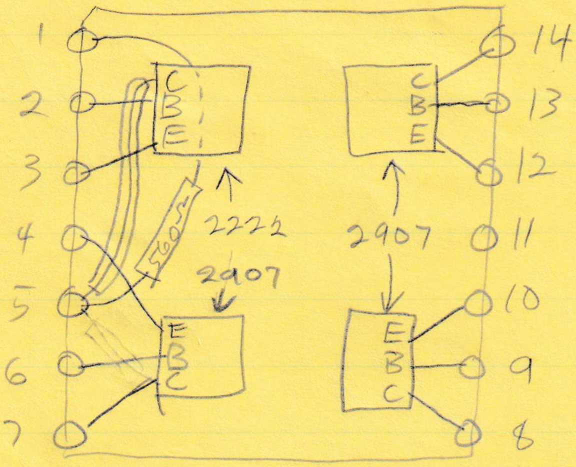
Gray level stairstep in

COLORIZER BUS MODS - FINAL FOR REV Ø



10/31/82
DWS

Priority Bus Driver + Terminator



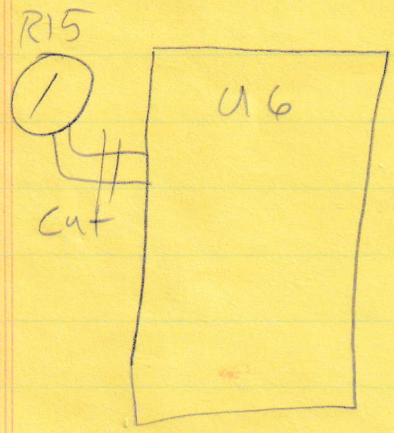
Replaces

U6 ONLY

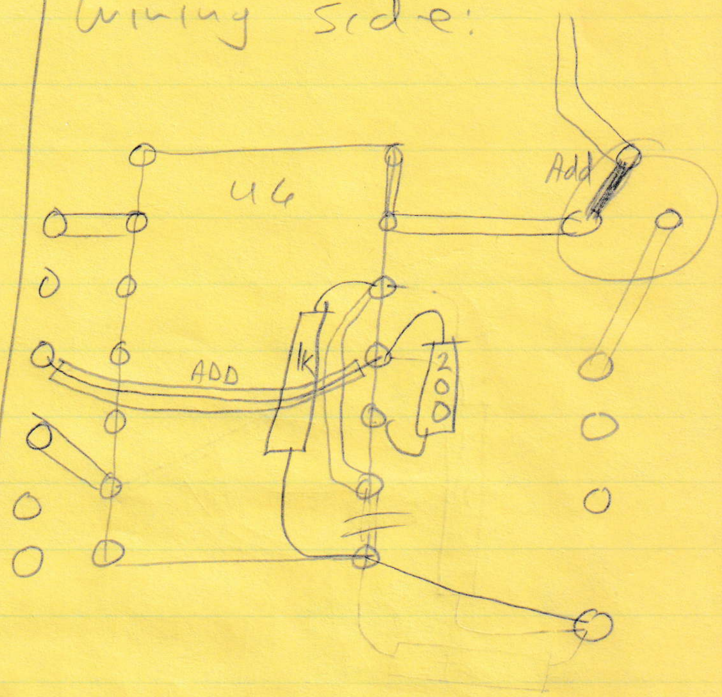
MAKE 5

Board Changes:

Component side

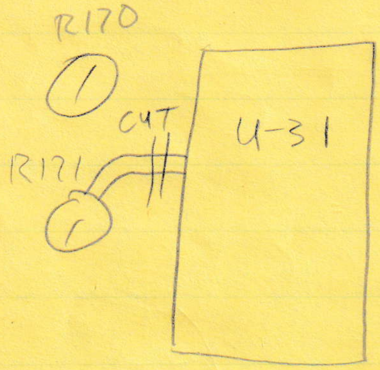


Wiring side:

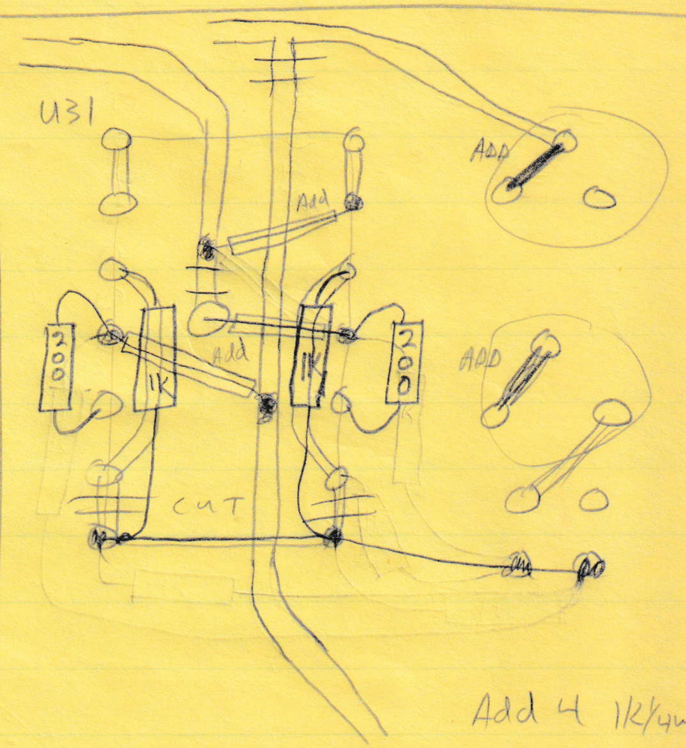


Comp. side	Trace side

U-31



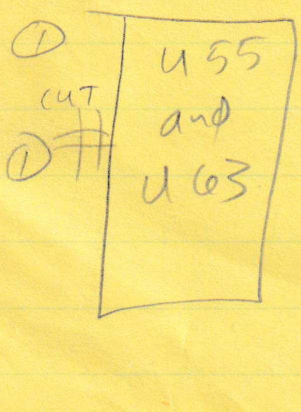
cut 1

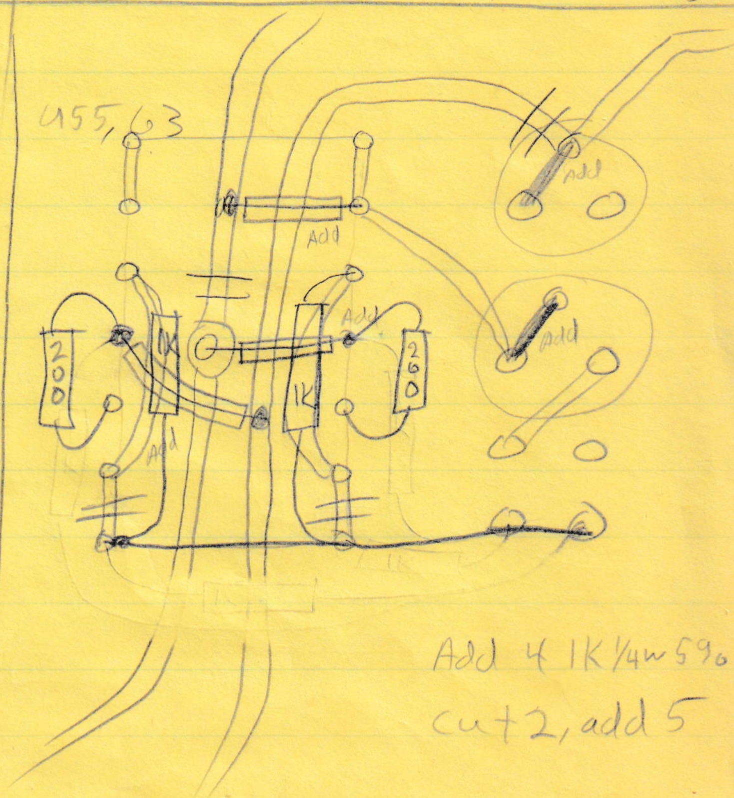


Add 4 1K/4w 5%
cut 2 add 5

U55
AND
U63

No change

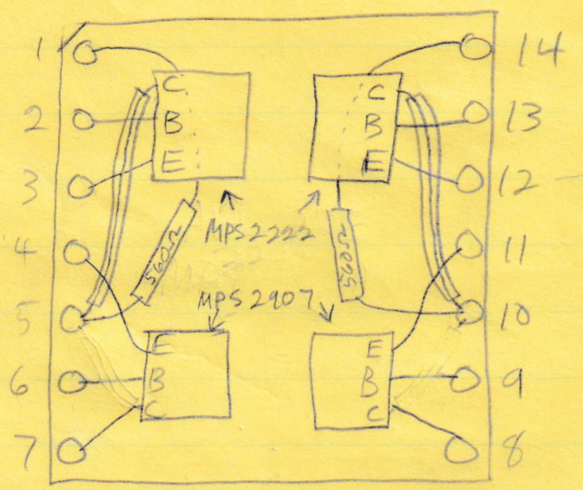




Add 4 1K 1/4w 5%
cut 2, add 5

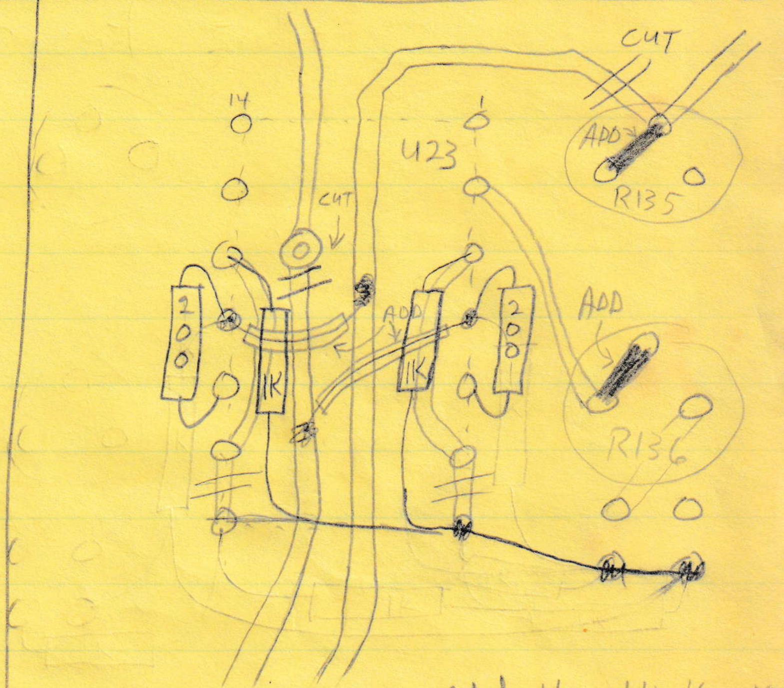
UCB-101 A BUS TERMINATOR PLUGS

TOP VIEW



Replaces
U-23, 31, 55, 63

Changes to boards:

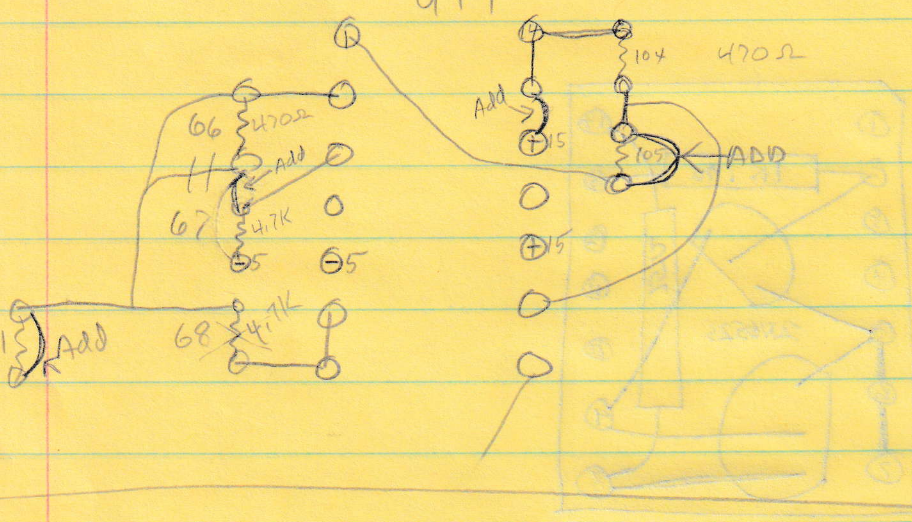
	COMPONENT SIDE	WIRING SIDE
U-23	NO change	

Add 4 1K 1/4w 5%
cut 2, Add 4

Colorizer Priority Arbitrator Fix:

Top (comp) view

414

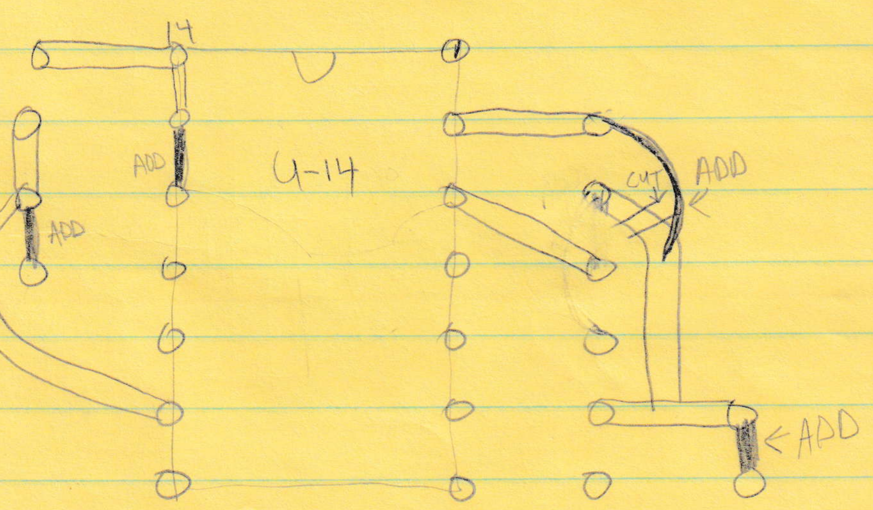


R41 - short   Remove R66

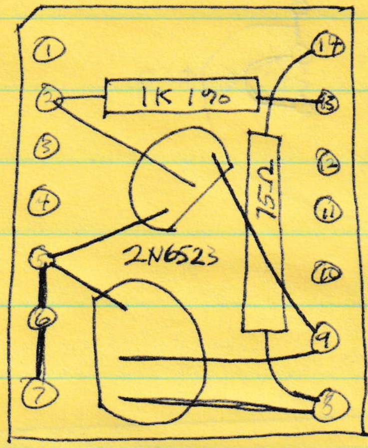
, R67 = 4.7K

, short 105

Rear View



U14 Plug



Stuffing List for VCB100A VCB

Reference No's	Part Name	Part Type	Description
C1	C 68UF 16V		No description found in cross ref file
C2	C 47UF 25V		No description found in cross ref file
C3-16	C .1UF 50V		No description found in cross ref file
C17	C 56 PF		No description found in cross ref file
C18-20	C .1UF 50V		No description found in cross ref file
C21-23	C 56 PF		No description found in cross ref file
C24	C .1UF 50V		No description found in cross ref file
C25-27	C 56 PF		No description found in cross ref file
C28	C 1UF 25V		No description found in cross ref file
C29 — OMIT	Reference not found in component list		
C30	C 1UF 25V		No description found in cross ref file
C31-33	C 56 PF		No description found in cross ref file
C34	C .1UF 50V		No description found in cross ref file
C35 .1uf	Reference not found in component list		
C36	C 1UF 25V		No description found in cross ref file
C37-39	C 56 PF		No description found in cross ref file
C40	C .1UF 50V		No description found in cross ref file
C41-43	C 56 PF		No description found in cross ref file
C44	C .1UF 50V		No description found in cross ref file
C45 .1uf	Reference not found in component list		
C46-47	C 56 PF		No description found in cross ref file
C48-56	C .1UF 50V		No description found in cross ref file
C57-58	C 10UF 25V T		No description found in cross ref file
C59	C .1UF 50V		No description found in cross ref file
C60-63	C .01UF 50V		No description found in cross ref file
C64-69	C .1UF 50V		No description found in cross ref file
C70	C .01UF 50V		No description found in cross ref file
C71	C 1UF 25V		No description found in cross ref file
C72	C .01UF 50V		No description found in cross ref file
C73	C 1UF 25V		No description found in cross ref file
C74	C .01UF 50V		No description found in cross ref file
C75	C 1UF 25V		No description found in cross ref file
C76	C .01UF 50V		No description found in cross ref file
C77	C 1UF 25V		No description found in cross ref file
C78	C .01UF 50V		No description found in cross ref file
C79	C 1UF 25V		No description found in cross ref file
C80-81	C .1UF 50V		No description found in cross ref file
C82	C .01UF 50V		No description found in cross ref file
C83	C 1UF 25V		No description found in cross ref file
C84	C .01UF 50V		No description found in cross ref file
C85	C 1UF 25V		No description found in cross ref file
C86	C .01UF 50V		No description found in cross ref file
C87	C 1UF 25V		No description found in cross ref file
C88	C .01UF 50V		No description found in cross ref file
C89	C 1UF 25V		No description found in cross ref file
C90	C .01UF 50V		No description found in cross ref file
C91	C 1UF 25V		No description found in cross ref file
C92	C .1UF 50V		No description found in cross ref file
C93	C .01UF 50V		No description found in cross ref file
C94	C 1UF 25V		No description found in cross ref file
C95	C .01UF 50V		No description found in cross ref file
C96	C 1UF 25V		No description found in cross ref file
C97	C .01UF 50V		No description found in cross ref file

Reference No's	Part Name	Part Type	Description
C98	C 1UF 25V		No description found in cross ref file
C99	C .01UF 50V		No description found in cross ref file
C100	C 1UF 25V		No description found in cross ref file
C101	C .01UF 50V		No description found in cross ref file
C102	C 1UF 25V		No description found in cross ref file
C103-105	C .1UF 50V		No description found in cross ref file
C106	C .01UF 50V		No description found in cross ref file
C107	C 1UF 25V		No description found in cross ref file
C108	C .01UF 50V		No description found in cross ref file
C109	C 1UF 25V		No description found in cross ref file
C110	C .01UF 50V		No description found in cross ref file
C111	C 1UF 25V		No description found in cross ref file
C112	C .01UF 50V		No description found in cross ref file
C113	C 1UF 25V		No description found in cross ref file
C114	C .01UF 50V		No description found in cross ref file
C115	C 1UF 25V		No description found in cross ref file
C116	C .1UF 50V		No description found in cross ref file
C117	C 1UF 25V		No description found in cross ref file
C118	C .01UF 50V		No description found in cross ref file
C119	C 1UF 25V		No description found in cross ref file
C120	C .01UF 50V		No description found in cross ref file
C121	C 1UF 25V		No description found in cross ref file
C122	C .01UF 50V		No description found in cross ref file
C123	C 1UF 25V		No description found in cross ref file
C124	C .01UF 50V		No description found in cross ref file
C125	C 1UF 25V		No description found in cross ref file
C126	C .01UF 50V		No description found in cross ref file
C127-128	C .1UF 50V		No description found in cross ref file
C129	C 1UF 25V		No description found in cross ref file
C130	C .01UF 50V		No description found in cross ref file
C131	C 1UF 25V		No description found in cross ref file
C132	C .01UF 50V		No description found in cross ref file
C133	C 1UF 25V		No description found in cross ref file
C134	C .01UF 50V		No description found in cross ref file
C135	C 1UF 25V		No description found in cross ref file
C136	C .01UF 50V		No description found in cross ref file
C137	C 1UF 25V		No description found in cross ref file
C138	C .01UF 50V		No description found in cross ref file
C139-142	C .1UF 50V		No description found in cross ref file
C143	C 1UF 25V		No description found in cross ref file
C144	C .01UF 50V		No description found in cross ref file
C145	C 1UF 25V		No description found in cross ref file
C146	C .01UF 50V		No description found in cross ref file
C147	C 1UF 25V		No description found in cross ref file
C148	C .01UF 50V		No description found in cross ref file
C149	C 1UF 25V		No description found in cross ref file
C150	C .01UF 50V		No description found in cross ref file
C151	C 1UF 25V		No description found in cross ref file
C152	C .01UF 50V		No description found in cross ref file
C153-154	C .1UF 50V		No description found in cross ref file
CR1-61	1N914	DIODE	SWITCHING DIODE

Reference No's	Part Name	Part Type	Description
CR62	1N5231B	DIODE	5V ZENER DIODE
CR63	1N5240B	DIODE	10V ZENER DIODE
CR64	1N5231B	DIODE	5V ZENER DIODE
CR65	1N5240B	DIODE	10V ZENER DIODE
CR66-90	1N914	DIODE	SWITCHING DIODE
I1-2	EJECTOR	HARDWARE	CAL107-1013 EJECTOR
J1-7	COAX-CONN	CONNECTOR	Amphenol #901-143 Coax-connector
Q1-3	2N3904	TRANSISTOR	MATCHING TRANSISTOR TO CA3046 ARRAY
R1	R 1 OHM 1/2W 1%	RESISTOR	1 OHM 1/2W 1% RESISTOR
R2-14	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R15	RV 5K BOURNS 3329	POT	5K 3329 ROUND-TOP ADJUST POT
R16	R 25K OHM 1/4W 1%	RESISTOR	25K OHM 1/4W 1% RESISTOR
R17	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R18	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R19	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R20	R 1 OHM 1/2W 1%	RESISTOR	1 OHM 1/2W 1% RESISTOR
R21	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R22	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R23	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R24	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R25	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R26	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R27	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R28	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R29	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R30	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R31	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R32	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R33	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R34	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R35	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R36	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R37	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R38	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R39-40	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R41	R 25K OHM 1/4W 1%	RESISTOR	25K OHM 1/4W 1% RESISTOR
R42-43	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R44	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R45	R 1.6K OHM 1/4W 1%	RESISTOR	1.6K OHM 1/4W 1% RESISTOR
R46	R 2K OHM 1/4W 1%	RESISTOR	2K OHM 1/4W 1% RESISTOR
R47-49	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R50	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R51-57	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R58	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R59-64	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR

Reference No's	Part Name	Part Type	Description
R65	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R66	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R67 4.7K	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R68 5.1 KΩ	Reference not found in component list		
R69	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R70	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R71	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R72-73	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R74	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R75	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R76-77	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R78	R 1.6K OHM 1/4W 1%	RESISTOR	1.6K OHM 1/4W 1% RESISTOR
R79	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R80 75Ω	Reference not found in component list		
R81	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R82	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R83	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R84	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R85	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R86	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R87	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R88	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R89	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R90	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R91	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R92	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R93	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R94	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R95	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R96	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R97	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R98	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R99	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R100	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R101	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R102	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R103	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R104 5.1KΩ	Reference not found in component list		
R105	R 25K OHM 1/4W 1%	RESISTOR	25K OHM 1/4W 1% RESISTOR
R106-107	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R108	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R109	R 680K OHM 1/4W 1%	RESISTOR	680K OHM 1/4W 1% RESISTOR
R110	R 330K OHM 1/4W 1%	RESISTOR	330K OHM 1/4W 1% RESISTOR
R111-112	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R113	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R114 6.2 K	Reference not found in component list		
R115	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R116-118	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R119	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R120 200Ω	Reference not found in component list		
R121-126	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R127	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R128-133	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR

Reference No's	Part Name	Part Type	Description
R134	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R135	RV 5K BOURNS 3329	POT	5K 3329 ROUND-TOP ADJUST POT
R136 5K TRIMPOT	Reference not found in component list		
R137-138	R 25K OHM 1/4W 1%	RESISTOR	25K OHM 1/4W 1% RESISTOR
R139	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R140	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R141	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R142-144	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R145	R 3K OHM 1/4W 1%	RESISTOR	3K OHM 1/4W 1% RESISTOR
R146	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R147	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R148	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R149	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R150	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R151	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R152	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R153	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R154	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R155	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R156	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R157	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R158	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R159	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R160	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R161	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R162	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R163	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R164	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R165	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R166	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R167	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R168	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R169	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R170-171	RV 5K BOURNS 3329	POT	5K 3329 ROUND-TOP ADJUST POT
R172-173	R 25K OHM 1/4W 1%	RESISTOR	25K OHM 1/4W 1% RESISTOR
R174-175	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R176	R 1.6K OHM 1/4W 1%	RESISTOR	1.6K OHM 1/4W 1% RESISTOR
R177	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R178	R 2K OHM 1/4W 1%	RESISTOR	2K OHM 1/4W 1% RESISTOR
R179-181	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R182	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R183-189	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R190	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R191-196	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R197	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R198	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R199	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R200	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R201-203	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R204	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R205	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R206	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R207	R 1.6K OHM 1/4W 1%	RESISTOR	1.6K OHM 1/4W 1% RESISTOR

Reference No's	Part Name	Part Type	Description
R208-209	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R210	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R211	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R212	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R213	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R214	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R215	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R216	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R217	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R218	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R219	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R220	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R221	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R222	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R223	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R224	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R225	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R226	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R227	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R228	R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR
R229	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R230	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R231	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R232	R 10 OHM 1/4W 1%	RESISTOR	10 OHM 1/4W 1% RESISTOR
R233	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R234	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R235	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R236	R 10 OHM 1/4W 1%	RESISTOR	10 OHM 1/4W 1% RESISTOR
R237-238	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R239-251	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R252	R 5.6K OHM 1/4W 1%	RESISTOR	5.6K OHM 1/4W 1% RESISTOR
R253	R 1.4K OHM 1/4W 1%	RESISTOR	1.4K OHM 1/4W 1% RESISTOR
R254	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R255	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R256	R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR
R257	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R258	R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR
R259	R 1.4K OHM 1/4W 1%	RESISTOR	1.4K OHM 1/4W 1% RESISTOR
R260	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R261	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R262	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R263	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R264-266	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R267	R 100K OHM 1/4W 1%	RESISTOR	100K OHM 1/4W 1% RESISTOR
R268	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R269	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R270	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R271	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R272	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R273	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R274	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R275	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R276	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR

Reference No's	Part Name	Part Type	Description
R277	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R278	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R279	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R280	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R281-282	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R283	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R284	R 680 OHM 1/4W 1%	RESISTOR	680 OHM 1/4W 1% RESISTOR
R285	R 2K OHM 1/4W 1%	RESISTOR	2K OHM 1/4W 1% RESISTOR
R286	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R287-299	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R300	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R301	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R302	R 10 OHM 1/4W 1%	RESISTOR	10 OHM 1/4W 1% RESISTOR
R303	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R304	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R305	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R306-307	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R308	R 1.6K OHM 1/4W 1%	RESISTOR	1.6K OHM 1/4W 1% RESISTOR
R309 100Ω	Reference not found in component list		
R310	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R311	R 2K OHM 1/4W 1%	RESISTOR	2K OHM 1/4W 1% RESISTOR
R312	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R313	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R314	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R315	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R316	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R317	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R318	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R319	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R320	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R321	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R322	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R323	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R324	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R325	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R326	R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR
R327	R 1.4K OHM 1/4W 1%	RESISTOR	1.4K OHM 1/4W 1% RESISTOR
R328	R 6.8K OHM 1/4W 1%	RESISTOR	6.8K OHM 1/4W 1% RESISTOR
R329 — 430Ω	Reference not found in component list		
R330	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R331	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R332	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R333	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R334	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R335	R 1.6K OHM 1/4W 1%	RESISTOR	1.6K OHM 1/4W 1% RESISTOR
R336-337	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R338-350	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R351-352	RV 5K BOURNS 3329	POT	5K 3329 ROUND-TOP ADJUST POT
R353-354	R 25K OHM 1/4W 1%	RESISTOR	25K OHM 1/4W 1% RESISTOR
R355	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R356	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R357	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R358-360	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR

Reference No's	Part Name	Part Type	Description
R361	R 100K OHM 1/4W 1%	RESISTOR	100K OHM 1/4W 1% RESISTOR
R362	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R363	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R364	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R365	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R366	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R367	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R368	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R369	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R370	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R371	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R372	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R373	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R374	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R375	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R376	R 100K OHM 1/4W 1%	RESISTOR	100K OHM 1/4W 1% RESISTOR
R377-389	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R390-391	RV 5K BOURNS 3329	POT	5K 3329 ROUND-TOP ADJUST POT
R392-393	R 25K OHM 1/4W 1%	RESISTOR	25K OHM 1/4W 1% RESISTOR
R394	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R395-396	R 430 OHM 1/4W 1%	RESISTOR	430 OHM 1/4W 1% RESISTOR
R397	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R398	R 680 OHM 1/4W 1%	RESISTOR	680 OHM 1/4W 1% RESISTOR
R399	R 2K OHM 1/4W 1%	RESISTOR	2K OHM 1/4W 1% RESISTOR
R400	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R401	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R402	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R403	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R404	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R405	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R406	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R407	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R408	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R409	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R410	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R411	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R412	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R413	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R414	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R415	R 680 OHM 1/4W 1%	RESISTOR	680 OHM 1/4W 1% RESISTOR
R416	R 2K OHM 1/4W 1%	RESISTOR	2K OHM 1/4W 1% RESISTOR
R417	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R418-430	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R431	R 1.6K OHM 1/4W 1%	RESISTOR	1.6K OHM 1/4W 1% RESISTOR
R432	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R433	R 2K OHM 1/4W 1%	RESISTOR	2K OHM 1/4W 1% RESISTOR
R434	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R435	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R436	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R437	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R438	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R439	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R440	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR

Reference No's	Part Name	Part Type	Description
R441	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R442	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R443	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R444	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R445	R 3.3K OHM 1/4W 1%	RESISTOR	3.3K OHM 1/4W 1% RESISTOR
R446	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R447-448	R 1 OHM 1/2W 1%	RESISTOR	1 OHM 1/2W 1% RESISTOR
R449	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R450	R 470 OHM 1/4W 1%	RESISTOR	470 OHM 1/4W 1% RESISTOR
R451	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R452	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R453	R 1.6K OHM 1/4W 1%	RESISTOR	1.6K OHM 1/4W 1% RESISTOR
R454-456	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R457	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R458	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R459	R 3K OHM 1/4W 1%	RESISTOR	3K OHM 1/4W 1% RESISTOR
R460	R 4.7K OHM 1/4W 1%	RESISTOR	4.7K OHM 1/4W 1% RESISTOR
R461	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R462	R 820 OHM 1/4W 1%	RESISTOR	820 OHM 1/4W 1% RESISTOR
R463	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R464	R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR
R465	R 820 OHM 1/4W 1%	RESISTOR	820 OHM 1/4W 1% RESISTOR
R466	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R467	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R468	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R469	R 2.7K OHM 1/4W 1%	RESISTOR	2.7K OHM 1/4W 1% RESISTOR
R470	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R471	R 3K OHM 1/4W 1%	RESISTOR	3K OHM 1/4W 1% RESISTOR
R472	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R473	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R474	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R475	R 6.2K OHM 1/4W 1%	RESISTOR	6.2K OHM 1/4W 1% RESISTOR
R476	R 4.7K OHM 1/4W 1%	RESISTOR	4.7K OHM 1/4W 1% RESISTOR
R477	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R478	R 820 OHM 1/4W 1%	RESISTOR	820 OHM 1/4W 1% RESISTOR
R479	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R480	R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR
R481	R 820 OHM 1/4W 1%	RESISTOR	820 OHM 1/4W 1% RESISTOR
R482	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R483	R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR
R484-488	R 5.6K OHM 1/4W 1%	RESISTOR	5.6K OHM 1/4W 1% RESISTOR
R489-493	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R494-498	R 5.6K OHM 1/4W 1%	RESISTOR	5.6K OHM 1/4W 1% RESISTOR
R499-503	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R504	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R505	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R506	R 51 OHM 1/4W 1%	RESISTOR	51 OHM 1/4W 1% RESISTOR
R507	R 6.2K OHM 1/4W 1%	RESISTOR	6.2K OHM 1/4W 1% RESISTOR
R508-512	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R513-514	R 5.6K OHM 1/4W 1%	RESISTOR	5.6K OHM 1/4W 1% RESISTOR
R515 5.6K	Reference not found in component list		
R516-517	R 5.6K OHM 1/4W 1%	RESISTOR	5.6K OHM 1/4W 1% RESISTOR
R518-522	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR

Reference No's	Part Name	Part Type	Description
R523-527	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R528-532	R 5.6K OHM 1/4W 1%	RESISTOR	5.6K OHM 1/4W 1% RESISTOR
R533-537	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R538-542	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R543-547	R 5.6K OHM 1/4W 1%	RESISTOR	5.6K OHM 1/4W 1% RESISTOR
R548-552	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
R553-557	R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR
R558	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R559	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R560	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R561	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R562	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R563	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R564	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R565	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R566	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R567	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R568	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R569	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R570	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R571	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R572	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R573	RP 2.2K SIP10		No description found in cross ref file
R574	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R575	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R576	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R577	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R578	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R579	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R580	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R581	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R582	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R583	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R584	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R585	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R586	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R587	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R588	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R589	R 2.2K OHM 1/4W 1%	RESISTOR	2.2K OHM 1/4W 1% RESISTOR
R590	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R591	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R592	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R593	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R594	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R595	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R596	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R597	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R598	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R599	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R600	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR
R601	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R602	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R603	R 47K OHM 1/4W 1%	RESISTOR	47K OHM 1/4W 1% RESISTOR

Reference No's	Part Name	Part Type	Description
R604	R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR
R605	R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR
SW1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
U1-5	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U6-7	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U8-13	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U14	MPQ6002	TRAN ARRAY	COMPLIMENTARY TRANSISTOR ARRAY
U15	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U16	AH0134	IC	DUAL ANALOG SWITCH
U17	~~MPQ2907~~ CA3046	TRAN ARRAY	PNP TRANSISTOR ARRAY
U18-22	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U23-24	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U25-30	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U31-32	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U33	AH0134	IC	DUAL ANALOG SWITCH
U34-38	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U39	MPQ6002	TRAN ARRAY	COMPLIMENTARY TRANSISTOR ARRAY
U40-41	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U42-46	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U47	MPQ6002	TRAN ARRAY	COMPLIMENTARY TRANSISTOR ARRAY
U48	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U49-54	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U55-56	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U57	AH0134	IC	DUAL ANALOG SWITCH
U58-62	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U63-64	MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY
U65-70	CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY
U71	Reference not found in component list MPQ2483		
U72	Reference not found in component list 2483		
U73	Reference not found in component list 74LS377		
U74	74LS240	IC	OCTAL BUS DRIVER
U75-78	AD558KN	IC	8 BIT DAC
U79	Reference not found in component list		
U80	74LS240	IC	OCTAL BUS DRIVER
U81-90	AD558KN	IC	8 BIT DAC
U91	Reference not found in component list		
U92	74LS138	IC	3-TO-8 LINE DECODER
U93-97	AD558KN	IC	8 BIT DAC
U98	Reference not found in component list		
U99	74LS138	IC	3-TO-8 LINE DECODER
U100-109	AD558KN	IC	8 BIT DAC
U110	Reference not found in component list		
U111	25LS2521	IC	8 BIT COMPARATOR
U112-116	AD558KN	IC	8 BIT DAC
U117 74LS02	Reference not found in component list 7428		
U118 74LS02	Reference not found in component list 7428		
U119	25LS2521	IC	8 BIT COMPARATOR
U120-124	AD558KN	IC	8 BIT DAC
U125	74S74	IC	DUAL D FLIP-FLOP

Reference No's	Part Name	Part Type	Description
U126	74LS240	IC	OCTAL BUS DRIVER
U127	74LS260	IC	DUAL 5-INPUT NOR GATE
U128	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT

file Name UCB.CL 12/30/81

BOARD#= VCB-100 VCB100
SERIAL#= 1
DESC= 200 OHM 5% 1/4W — PARTNAME Edit R_200_5%_1/4W
REFCHR= R
2,3,5,4,6,27,7,8,31,9,11,10,12,35,14,13,47,48,86,49,52,51,53,90,54,55,94,56,
60,59,61,98,63,62,103,64,116,117,152,118,121,126,122,156,123,124,160,125,
129,128,130,164,132,131,169,133,179,180,214,181,184,183,185,218,186,187,222,
188,192,191,193,226,195,194,231,196,239,240,242,241,243,272,244,245,275,246,
248,247,249,278,251,250,287,288,290,289,291,316,292,293,319,294,296,295,297,
322,299,298,338,339,341,340,342,366,343,344,369,345,347,346 348,372,350,349,
377,378,380,379,381,405,382,383,408,384,386,385,387,411,389,388,418,419,421,
420,422,438,423,424,441,425,427,426,428,444,430,429,57,~~126~~,189,40,39,17,19,
43,42,66,70,140,199,262,304,356,467,463,483,479

C 1%

DESC= 1K OHM 5% 1/4W — PARTNAME Edit R_1K_5%_1/4W
50,85,58,65,102,119,151,127,134,168,182,213,190,197,230,572,569,566,563,560,
576,579,582,585,588,592,595,598,601,604,74,206,334,~~335~~ 452

DESC= 2.7K OHM 5% 1/4W PARTNAME Edit R_2.7K_5%_1/4W
23,26,30,34,38,84,89,93,97,101,150,155,159,163,167,212,217,221,225,229,269,
271,274,277,280,313,315,318,321,324 363,365,368,371,374,402,404,407,410,413,
435,437,440,443,446,457,469

DESC= 3.3K OHM 5% 1/4W Edit R_3.3K_5%_1/4W
268,270,273,276,279,312,314,317,320,323,362,364,367,370,373,401,403,406,409,
412,434,436,439,442,445

DESC= 15K OHM 1/4W 5% R_15K_5%_1/4W
22,25,29,33,37,83,88,92,96,100,149,154,158,162,166,211,216,220,224,228

DESC= 6.8K OHM 1/4W 5% R_6.8K_5%_1/4W
21,24,28,32,36,82,87,91,95,99,148,153,157,161,165,210,215,219,223,227,254,
260,328

DESC= 25K OHM 1/4W 5% R_25K_5%_1/4W
16,41,137,105,~~138~~,172,173,353,354,392,393

DESC= 100 OHM 1/4W 5% R_100_5%_1/4W
255,257,325,69,72,73,139,142,143,198,201,202,261,264,265,303,306,307,355,358,
359,553,554,555,556,557,538,539,540,541,542,523,524,525,526,527,508,509,510,
511,512,466,461,482,477,456,504,468,472,77,79,76,44,81,111,144,108,112,208,
203,177,205,209,266,~~284~~ 283,336,331,337,333,360,414,454,451,449,432,455,375,
397

DESC= 430 OHM 1/4W 1% R_430_1%_1/4W
71,107,106,141,175,174,200,238,237,263,282,281,305,330,~~324~~ 357,396,395

DESC= 1.4K OHM 1/4W 5% R_1.4K_5%_1/4W
253,259,327

DESC= 470 OHM 1/4W 5% R_470_5%_1/4W
18,67,310,234,301,75,204,332,450

DESC= 2.4K OHM 1/4W 5% R_2.4K_5% 1/4W
256,258,326,480,464

DESC= 10 OHM 1/4W 5% R_10_5%_1/4W
236,232,302

DESC= 51 OHM 1/4W 5% R_51_1%_1/4W

ALL '5%' Should Be '1%'

3.3K

C45,35

R394 - 10K

R 68

R 104

R 80

~~R110~~ - 330K

309 -

R114 -

329 -

235,233,300,458,506,470,474,147,115,286,417,400

DESC= 5K OHM TRIMPOTS BOURNS TYPE 3329 ?
15,135,~~138~~,170,171,351,352,390,391
138

REFCHR= CR
DESC= DIODE 1N914
1-61,66-90

REFCHR= Q
DESC= TRANSISTOR 2N3904
1-3

REFCHR= C
DESC= 56 PF C_56PF.
17,22,21,23,26,25,27,32,31,33,38,37,39,42,41,43,47,46

DESC= 10 UF TANTALUM 25V C_10UF_25V_T
PART#= T392C106K025AS
MAN= KEMET
57,58

REFCHR= U
DESC= CA3046
1,2,3,4,5,9,10,11,12,13,18,19,20,21,22,26,27,28,29,30,34,35,36,37,38,42,43,44,
45,46,50,51,52,53,54,58,59,60,61,62,65,66,67,68,69,8,25,49,70

DESC= MPQ2907
6,7,23,31,55,63,15,24,32,40,48,56,17,41,64

DESC= MPQ6002
14,39,47

REFCHR= R
DESC= 10K OHM 5% 1/4W R_10K_5%_1/4W
558,561,564,567,570,574,577,580,583,586,590,593,596,599,602,394

DESC= 47K OHM 5% 1/4W R_47K_5%_1/4W
559,562,565,568,571,575,578,581,584,587,591,594,597,600,603

DESC= 1.3K OHM 5% 1/4W R_1.3K_5%_1/4W
489,490,491,492,493,499,500,501,502,503,518,519,520,521,522,533,534,535,536,
537,548,549,550,551,552,505,473,605,113

DESC= 5.6K OHM 5% 1/4W R_5.6K_5%_1/4W
484,485,486,487,488,494,495,496,497,498,513,514,516,517,528,529,530,531,532,
543,544,545,546,547,252

DESC= 4.7K OHM 5% 1/4W R_4.7K_5%_1/4W
460,476

DESC= 820 OHM 5% 1/4W R_820_5%_1/4W
465,462,481,478

DESC= 3K OHM 5% 1/4W R_3K_5%_1/4W
459,471,145

DESC= 6.2K OHM 5% 1/4W R_6.2K_5%_1/4W
507,475

DESC= 2.7K OHM 5% 1/4W R_2.7K_5%_1/4W
~~467~~, ~~469~~, 146

DESC= 2.2K OHM 5% 1/4W R_2.2K_5%_1/4W
389

DESC= SIP 2.2K X 9 RP_2.2K_SIP10
PART#= 9510E13A2201GL002
MAN= MEPCO
573

REFCHR= C
DESC= 68 UF 16 V C_68UF_16V
PART#= T390E686M016AS
MAN= KEMET
1, 57, 58

REFCHR= C
DESC= 47 UF 25 V C_47UF_25V
PART#= T390E476M025AS
MAN= KEMET
2

REFCHR= C
DESC= 1 UF 25 V C_1UF_25V
PART#= T392A105K025AS
MAN= KEMET
73, 75, 77, 79, 71, 83, 85, 87, 89, 91, 94, 96, 98, 100, 102, 107, 109, 111, 113, 115, 117, 119, 121,
123, 125, 129, 131, 133, 135, 137, 143, 145, 147, 149, 151, 28, 30, 36

DESC= .1 UF 50 V C_.1UF_50V_C
PART#= C323C104M5R5CA
MAN= KEMET
3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 24, 34, 40, 44, 48, 49, 50, 51, 52, 53, 54, 55
56, 59, 64, 65, 66, 67, 68, 69, 80, 81, 92, 103, 105, 104, 116, 127, 128, 139, 140, 141, 142, 153,
154

REFCHR= CR
DESC= 1N5240B 10V ZENER
63, 65

DESC= 1N5231B 5.1 V ZENER
62, 64

REFCHR= C
DESC= .01 UF 50 V C_.01UF_50V_C 2 boards only so far
PART# C323C123MR5CA
106, 108, 110, 112, 114, 93, 95, 97, 99, 101, 82, 84, 86, 88, 90, 70, 72, 74, 76, 78, 60, 61, 62, 63,
118, 120, 122, 124, 126, 130, 132, 134, 136, 138, 144, 146, 148, 150, 152

REFCHR= U
DESC= AH0134
16, 33, 57

AD558JN

DESC= AD 558 JN ANALOG DEVICES
100-109, 93-97, 112-116, 86-90, 120-124, 81-85, 75-78

DESC= AMD 25LS2521

119, 111

DESC= 74138
92, 99

DESC= 74LS240
74, 80, 126

DESC= 74260
127

DESC= 74574
125

DESC= 74538
128

REFCHR= J
DESC= #901-143
MAN= AMPHENOL
1-7 ?

REFCHR= 1
DESC= #107-1013
MAN= CALMARK
1-2 ?

REFCHR= R
DESC= 1 OHM 1/2W 5% R-1-5%-1/2W
1, 20, 447, 448

REFCHR= R R-2K-5%-1/4W
DESC= 2K OHM 1/4W 5%
46, 178, 311, 433, 285, 416, 399

DESC= 100K OHM 1/4W 5% R-100K-5%-1/4W
267, 361, 376

DESC= 680 OHM 1/4W 5% R-680-5%-1/4W
398, 415, 284 CORRECT

DESC= 1.6K OHM 1/4W 5% R-1.6K-5%-1/4W
78, 45, 207, 176, 335, 308, 453, 431
correct

DESC= 330K OHM 1/4W 5% R-330K-5%-1/4W
110

DESC= 680K OHM 1/4W 5% R-680K-5%-1/4W
109
PRINT

PRINT

QUIT

VCB

Order Form for VCB100

Total	Part Name	Distributor	Manufacturer	Part Number	P. O. Number	Quantity	Price	Due Date
2	#107-1013	ANTHEM	NEC	uPD7220				
7	#901-143							
2	1N5231B							
2	1N5240B							
86	1N914							
2	25LS2521	HAMILTON	AMD	25LS2521	1			
3	2N3904							
2	74138				2			
1	74260				3			
1	74S38				4			
1	74S74				5			
3	74LS240	HAMILTON	ANY	74LS240	6			
39	AD558JN				7			
3	AH0134				8			
39	C .01 UF 50V							
52	C .1 UF 50V							
38	C 1 UF 25V							
2	C 10 UF 25V T							
1	C 47 UF 25V							
18	C 56. PF							
1	C 68 UF 16V							
49	CA3046				9			
15	MPQ2907				10			
3	MPQ6002				11			
4	R 1 OHM 1% 1/2W							
29	R 1.3K OHM 1% 1/4W							
3	R 1.4K OHM 1% 1/4W							

Total	Part Name	Distributor	Manufacturer	Part Number	P.O. Number	Quantity	Price	Due Date
8	R 1.6K OHM 1% 1/4W							
3	R 10 OHM 1% 1/4W							
78	R 100 OHM 1% 1/4W							
3	R 100K OHM 1% 1/4W							
16	R 10K OHM 1% 1/4W							
20	R 15K OHM 1% 1/4W							
34	R 1K OHM 1% 1/4W							
1	R 2.2K OHM 1% 1/4W							
1	R 2.2K SIP10							
5	R 2.4K OHM 1% 1/4W							
48	R 2.7K OHM 1% 1/4W							
175	R 200 OHM 1% 1/4W							
11	R 25K OHM 1% 1/4W							
7	R 2K OHM 1% 1/4W							
25	R 3.3K OHM 1% 1/4W							
1	R 330K OHM 1% 1/4W							
3	R 3K OHM 1% 1/4W							
2	R 4.7K OHM 1% 1/4W							
17	R 430 OHM 1% 1/4W							
9	R 470 OHM 1% 1/4W							
15	R 47K OHM 1% 1/4W							
25	R 5.6K OHM 1% 1/4W							
12	R 51 OHM 1% 1/4W							
2	R 6.2K OHM 1% 1/4W							
23	R 6.8K OHM 1% 1/4W							
3	R 680 OHM 1% 1/4W							
1	R 680K OHM 1% 1/4W							

Total	Part Name	Distributor	Manufacturer	Part Number	P.O. Number	Quantity	Price	Due Date
4	R 820 OHM 1% 1/4W							
8	RV 5K OHM TYPE:A							

VCB

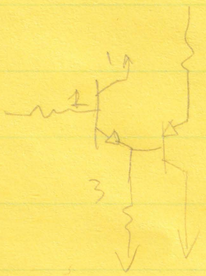
Reference No's	Total	Part Name	Part Type	Description
C1	1	C 68 UF 16V		No description found in cross ref file
C2	1	C 47 UF 25V		No description found in cross ref file
C3-16, 18-20, 24, 34, 40, 44, 48-56, 59, 64-69, 80-81, 92, 103-105, 116, 127-128, 139-142, 153-154	52	C .1 UF 50V		No description found in cross ref file
C17, 21-23, 25-27, 31-33, 37-39, 41-43, 46-47	18	C 56 PF		No description found in cross ref file
C28, 30, 36, 71, 73, 75, 77, 79, 83, 85, 87, 89, 91, 94, 96, 98, 100, 102, 107, 109, 111, 113, 115, 117, 119, 121, 123, 125, 129, 131, 133, 135, 137, 143, 145, 147, 149, 151	38	C 1 UF 25V		No description found in cross ref file
C57-58	2	C 10 UF 25V 1		No description found in cross ref file
C60-63, 70, 72, 74, 76, 78, 82, 84, 86, 88, 90, 93, 95, 97, 99, 101, 106, 108, 110, 112, 114, 118, 120, 122, 124, 126, 130, 132, 134, 136, 138, 144, 146, 148, 150, 152	39	C .01 UF 50V		No description found in cross ref file
CR1-61, 66-90	86	1N914		No description found in cross ref file
CR62, 64	2	1N5231B		No description found in cross ref file
CR63, 65	2	1N5240B		No description found in cross ref file
I1-2	2	#107-1013		No description found in cross ref file
J1-7	7	#901-143		No description found in cross ref file
Q1-3	3	2N3904		No description found in cross ref file
R1, 20, 447-448	4	R 1 OHM 1% 1/2W		No description found in cross ref file
R2-14, 17, 19, 27, 31, 35, 39-40, 42-43, 47-49, 51-57, 59-64, 66, 70, 86, 90, 94, 98, 103, 116-118, 121-126, 128-133, 140, 152, 156, 160, 164, 169, 179-181, 183-189, 191-196, 199,	175	R 200 OHM 1% 1/4W		No description found in cross ref file

Reference No's	Total	Part Name	Part Type	Description
214,218,222,226,231, 239-251,262,272,275, 278,287-299,304,316, 319,322,338-350,356, 366,369,372,377-389, 405,408,411,418-430, 438,441,444,463,467, 479,483				
R15,135,170-171, 351-352,390-391	8	RV 5K OHM TYPE:A		No description found in cross ref file
R16,41,105,137-138, 172-173,353-354, 392-393	11	R 25K OHM 1% 1/4W		No description found in cross ref file
R18,67,75,204,234, 301,310,332,450	9	R 470 OHM 1% 1/4W		No description found in cross ref file
R21,24,28,32,36,82, 87,91,95,99,148,153, 157,161,165,210,215, 219,223,227,254,260, 328	23	R 6.8K OHM 1% 1/4W		No description found in cross ref file
R22,25,29,33,37,83, 88,92,96,100,149, 154,158,162,166,211, 216,220,224,228	20	R 15K OHM 1% 1/4W		No description found in cross ref file
R23,26,30,34,38,84, 89,93,97,101,146, 150,155,159,163,167, 212,217,221,225,229, 269,271,274,277,280, 313,315,318,321,324, 363,365,368,371,374, 402,404,407,410,413, 435,437,440,443,446, 457,469	48	R 2.7K OHM 1% 1/4W		No description found in cross ref file
R44,69,72-73,76-77, 79,81,108,111-112, 139,142-144,177,198, 201-203,205,208-209, 255,257,261,264-266, 283,303,306-307,325, 331,333,336-337,355, 358-360,375,397,414, 432,449,451,454-456, 461,466,468,472,477, 482,504,508-512, 523-527,538-542,	78	R 100 OHM 1% 1/4W		No description found in cross ref file

Reference No's	Total	Part Name	Part Type	Description
553-557				
R45,78,176,207,308, 335,431,453	8	R 1.6K OHM 1% 1/4W		No description found in cross ref file
R46,178,285,311,399, 416,433	7	R 2K OHM 1% 1/4W		No description found in cross ref file
R50,58,65,74,85,102, 119,127,134,151,168, 182,190,197,206,213, 230,334,452,560,563, 566,569,572,576,579, 582,585,588,592,595, 598,601,604	34	R 1K OHM 1% 1/4W		No description found in cross ref file
R71,106-107,141, 174-175,200,237-238, 263,281-282,305,330, 357,395-396	17	R 430 OHM 1% 1/4W		No description found in cross ref file
R109	1	R 680K OHM 1% 1/4W		No description found in cross ref file
R110	1	R 330K OHM 1% 1/4W		No description found in cross ref file
R113,473,489-493, 499-503,505,518-522, 533-537,548-552,605	29	R 1.3K OHM 1% 1/4W		No description found in cross ref file
R115,147,233,235, 286,300,400,417,458, 470,474,506	12	R 51 OHM 1% 1/4W		No description found in cross ref file
R145,459,471	3	R 3K OHM 1% 1/4W		No description found in cross ref file
R232,236,302	3	R 10 OHM 1% 1/4W		No description found in cross ref file
R252,484-488, 494-498,513-514, 516-517,528-532, 543-547	25	R 5.6K OHM 1% 1/4W		No description found in cross ref file
R253,259,327	3	R 1.4K OHM 1% 1/4W		No description found in cross ref file
R256,258,326,464, 480	5	R 2.4K OHM 1% 1/4W		No description found in cross ref file
R267,361,376	3	R 100K OHM 1% 1/4W		No description found in cross ref file
R268,270,273,276, 279,312,314,317,320, 323,362,364,367,370, 373,401,403,406,409,	25	R 3.3K OHM 1% 1/4W		No description found in cross ref file

VCB

Reference No's	Total	Part Name	Part Type	Description
412,434,436,439,442, 445				
R284,398,415	3	R 680 OHM 1% 1/4W		No description found in cross ref file
R394,558,561,564, 567,570,574,577,580, 583,586,590,593,596, 599,602	16	R 10K OHM 1% 1/4W		No description found in cross ref file
R460,476	2	R 4.7K OHM 1% 1/4W		No description found in cross ref file
R462,465,478,481	4	R 820 OHM 1% 1/4W		No description found in cross ref file
R475,507	2	R 6.2K OHM 1% 1/4W		No description found in cross ref file
R559,562,565,568, 571,575,578,581,584, 587,591,594,597,600, 603	15	R 47K OHM 1% 1/4W		No description found in cross ref file
R573	1	R 2.2K SIP10		No description found in cross ref file
R589	1	R 2.2K OHM 1% 1/4W		No description found in cross ref file
U1-5,8-13,18-22, 25-30,34-38,42-46, 49-54,58-62,65-70	49	CA3046		No description found in cross ref file
U6-7,15,17,23-24, 31-32,40-41,48, 55-56,63-64	15	MPQ2907		No description found in cross ref file
U14,39,47	3	MPQ6002		No description found in cross ref file
U16,33,57	3	AH0134		No description found in cross ref file
U74,80,126	√ 3	74LS240	IC	OCTAL BUS DRIVER
U75-78,81-90,93-97, 100-109,112-116, 120-124	√ 39	AD558JN		No description found in cross ref file
U92,99	2	74138		No description found in cross ref file
U111,119	2	25LS2521	IC	8 BIT COMPARATOR
U125	1	74S74		No description found in cross ref file
U127	1	74260		No description found in cross ref file
U128	1	74S38		No description found in cross ref file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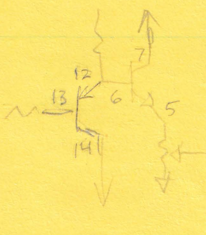
2
3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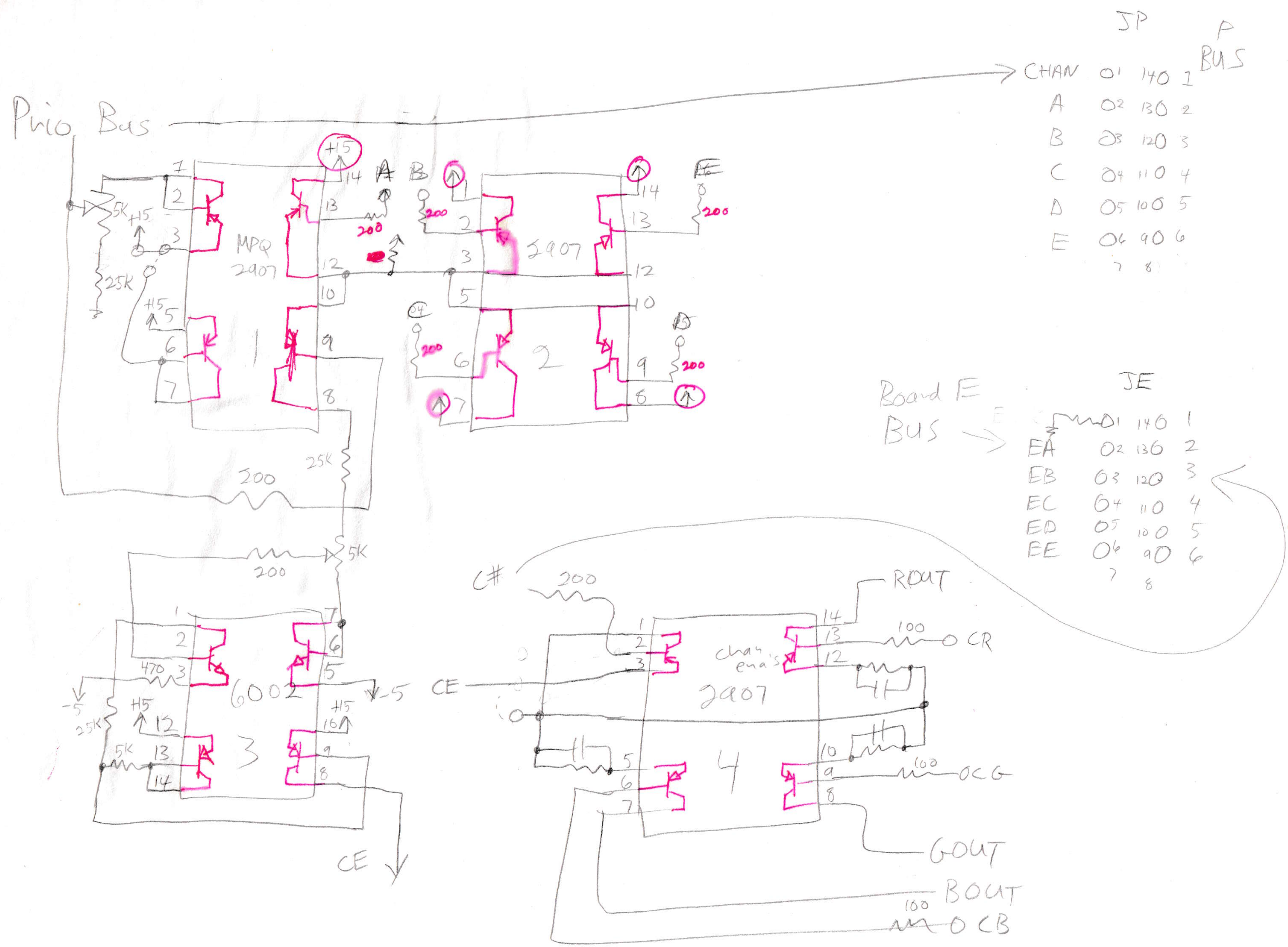
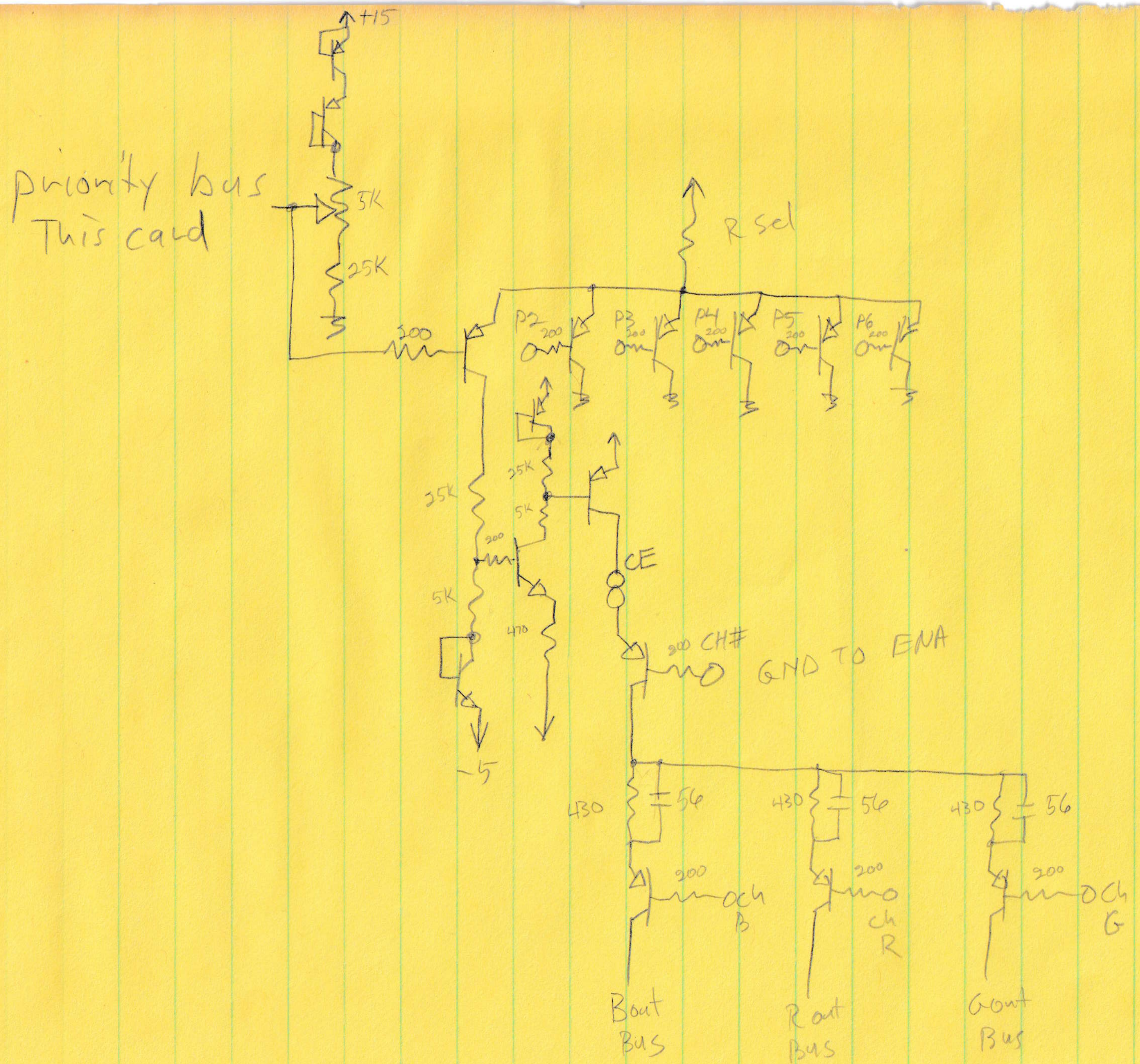
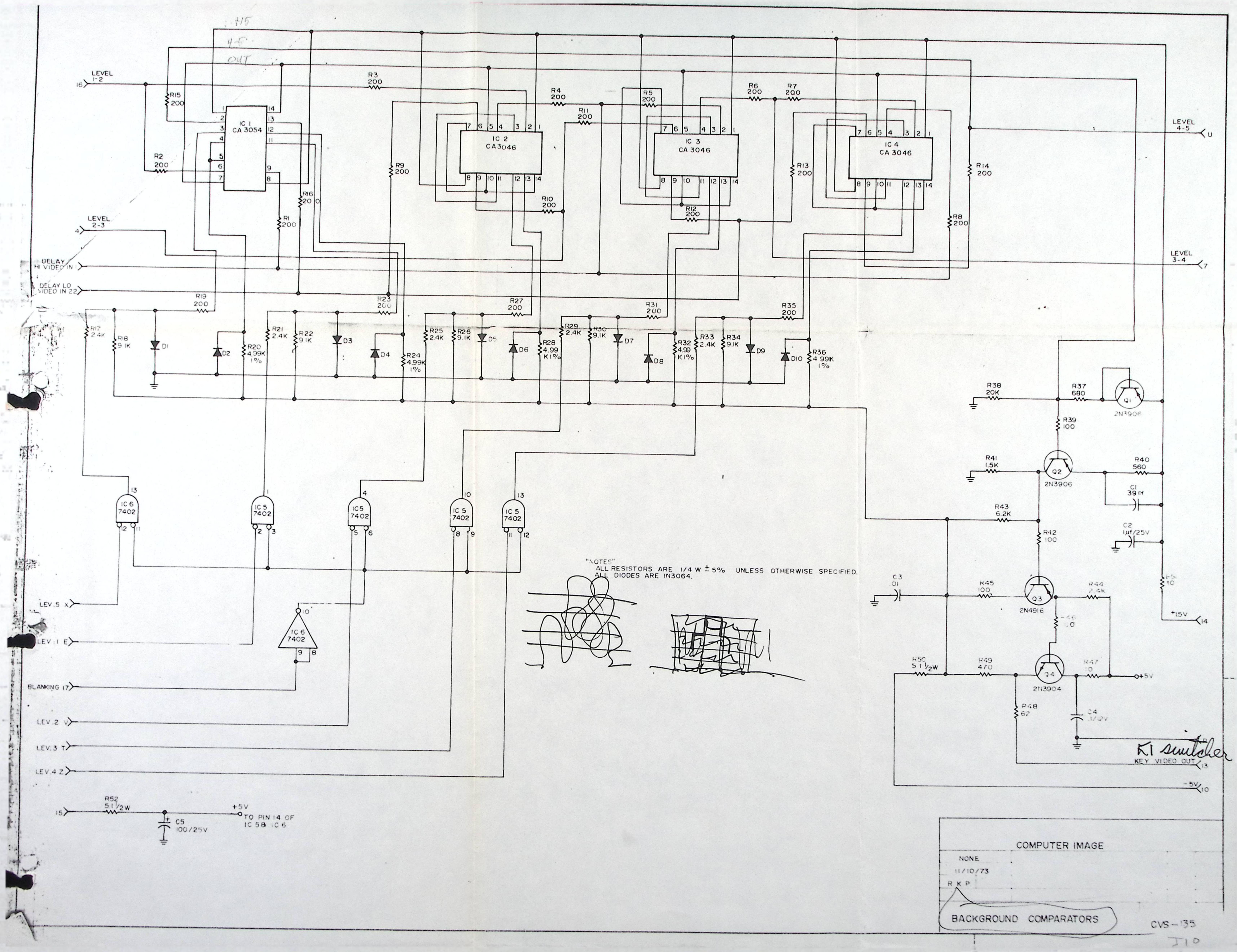
14


Prio Bus
JP
P BUS
CHAN 01 140 1
A 02 130 2
B 03 120 3
C 04 110 4
D 05 100 5
E 06 90 6
7 8
+5
MPQ 2907
2907
200
5K
25K
Board E Bus
JE
01 140 1
EA 02 130 2
EB 03 120 3
EC 04 110 4
ED 05 100 5
EE 06 90 6
7 8
6002
470
-5
CE
C#
ROUT
100
CR
chan ena's
2907
OCG
GOUT
BOUT
OCB

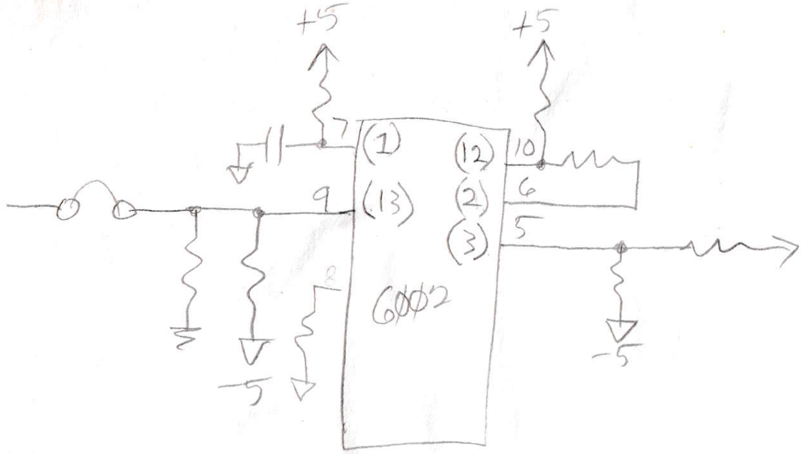


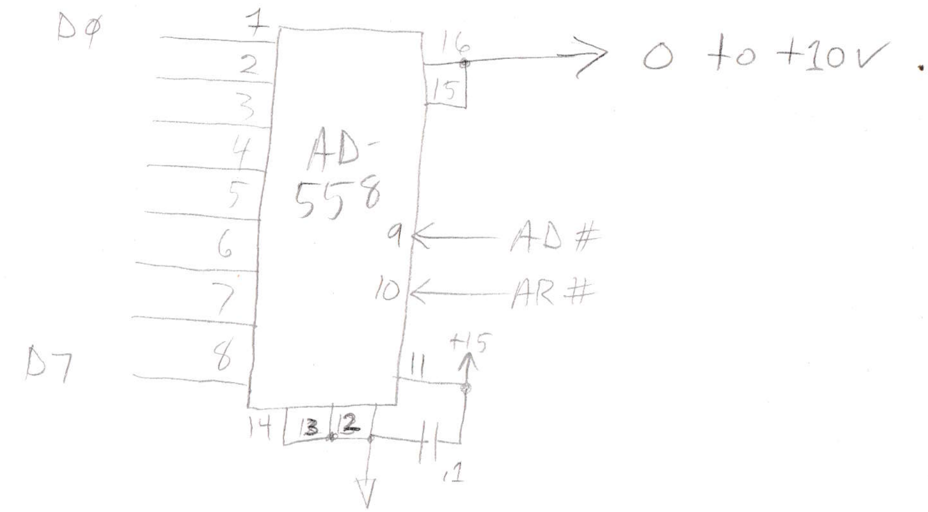
+15
priority bus
This card
3K
25K
200
P2
P3
P4
P5
P6
200
R sel
25K
25K
5K
200
5K
470
CE
200 CH#
GND TO ENA
-5
430
56
200
ch B
ch R
ch G
Bout Bus
R out Bus
Gout Bus

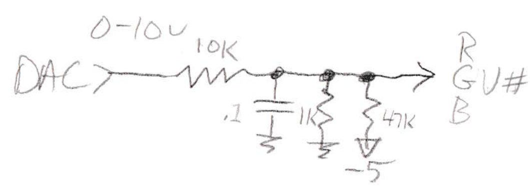


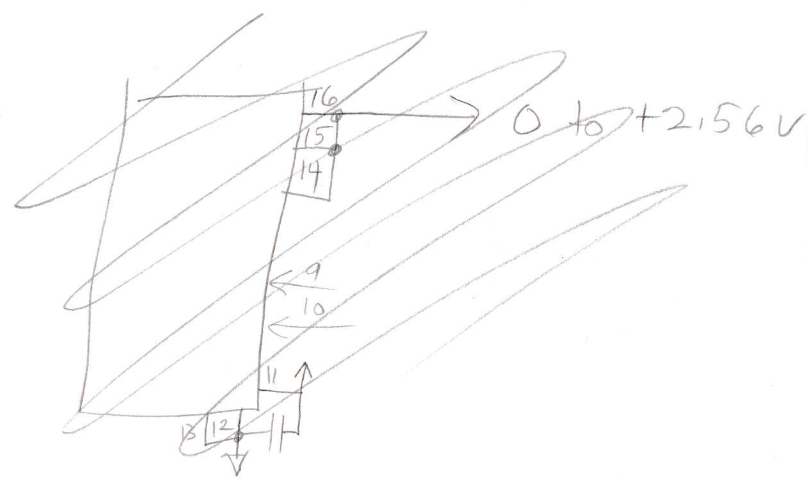
LEVEL 1-2
LEVEL 2-3
DELAY HI VIDEO IN
DELAY LO VIDEO IN
LEVEL 4-5
LEVEL 3-4
IC 1 CA 3054
IC 2 CA3046
IC 3 CA 3046
IC 4 CA 3046
IC 5 7402
IC 6 7402
LEV 5 X
LEV 1 E
BLANKING (17)
LEV 2 V
LEV 3 T
LEV 4 Z
+5V TO PIN 14 OF IC 5 & IC 6
C5 100/25V
R52 5.1 1/2W
"NOTES"
ALL RESISTORS ARE 1/4 W ± 5% UNLESS OTHERWISE SPECIFIED.
ALL DIODES ARE IN3064.
Q1 2N3906
Q2 2N3906
Q3 2N4916
Q4 2N3904
+15V
+5V
-5V
KEY VIDEO OUT
KI switcher
COMPUTER IMAGE
NONE
11/10/73
R K P
BACKGROUND COMPARATORS
CVS-135
J10

OUT AMP

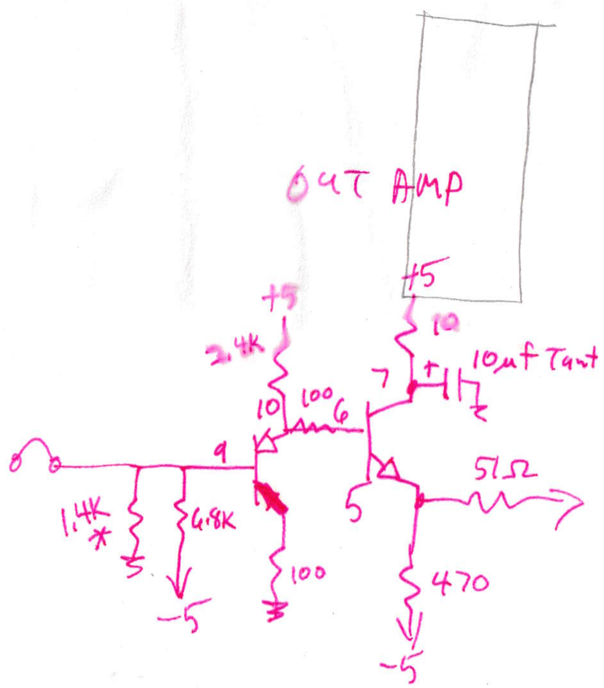


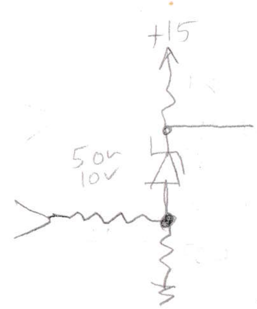


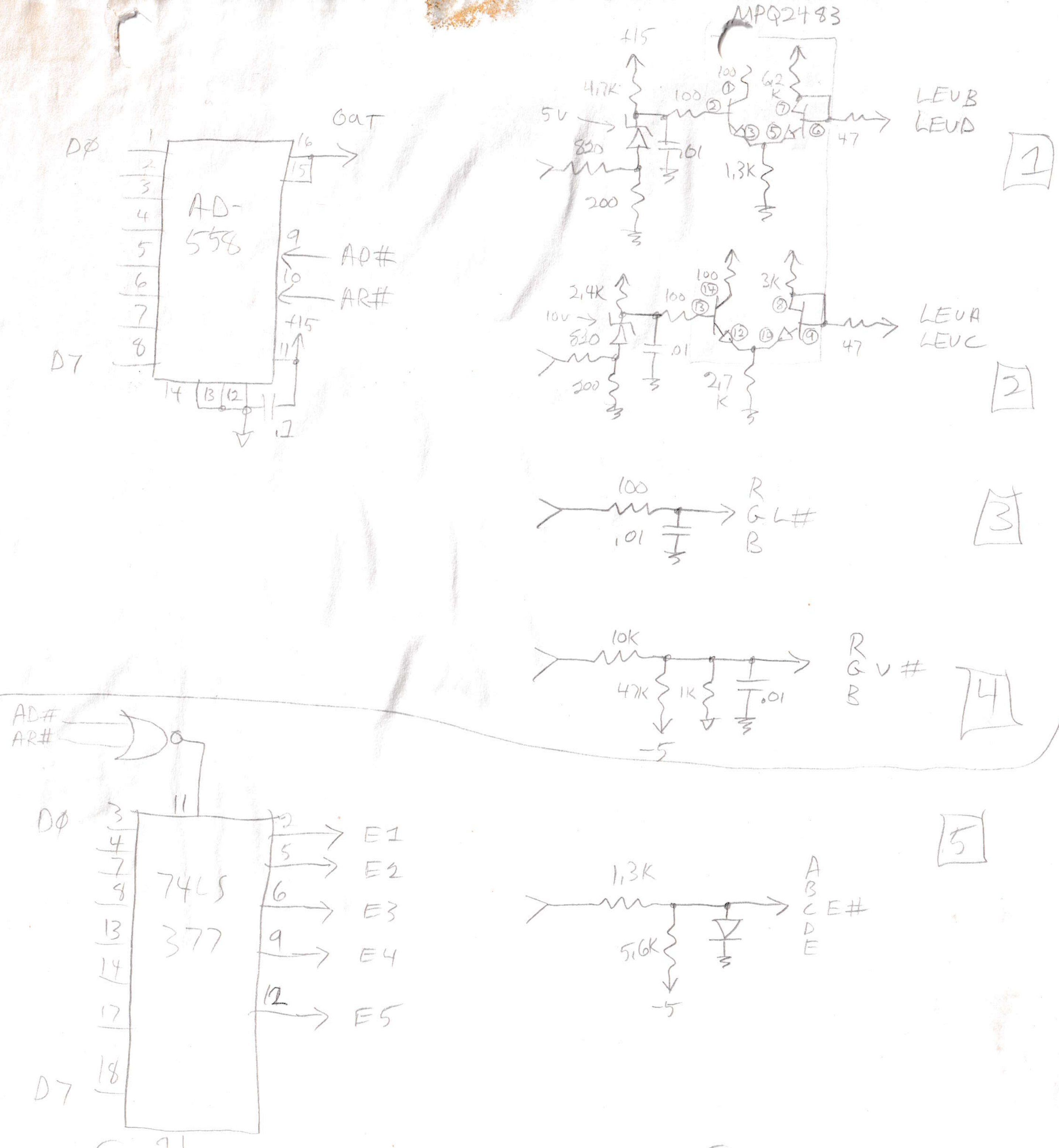




OUT AMP







DAC's		AD#	AR#
LEUA	$\boxed{2}$	0	0
LEUB	$\boxed{1}$	1	0
LEUC	$\boxed{2}$	2	0
LEUD	$\boxed{1}$	3	0
PR1-5	$\boxed{3}$	0-4	1
RL1-5	$\boxed{3}$	0-4	2
GL1-5	$\boxed{3}$	0-4	3
BL1-5	$\boxed{3}$	0-4	4
RU1-5	$\boxed{4}$	0-4	5
GU1-5	$\boxed{4}$	0-4	6
BU1-5	$\boxed{4}$	0-4	7
Register			
AE1-5	$\boxed{5}$	5	2
BE1-5	$\boxed{5}$	5	3
CE1-5	$\boxed{5}$	5	4
DE1-5	$\boxed{5}$	5	5
EE1-5	$\boxed{5}$	5	6

COLORIZER DAC's,
Registers and
Level shifts

MPQ 2483 - 4X NPN LIN. Preamp

MPQ 6002 COMP 2222+2907

MPQ 6700 COMP 3904+3906

MPQ 2907 4X PNP

6700

1	N	C	N	14
2	P	B	P	13
3	N	E	N	12
4	X	X	X	11
5	P	E	P	10
6	N	B	N	9
7	P	C	P	8

6002

1	N	C	P	14
2	P	B	N	13
3	N	E	P	12
	X	X	X	
5	N	E	P	10
6	P	B	N	9
7	N	C	P	8

2483

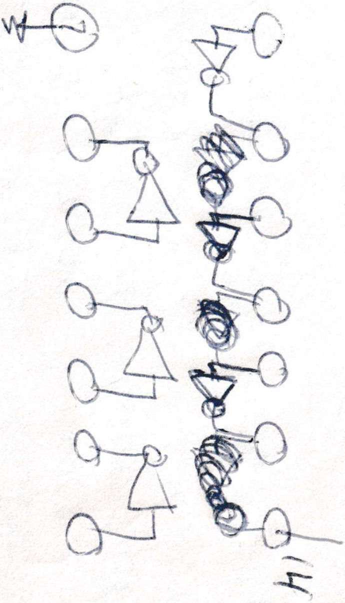
1	N	C	N	14
2	P	B	P	13
3	N	E	N	12
	X	X	X	
5	N	E	N	10
6	P	B	P	9
7	N	C	N	8

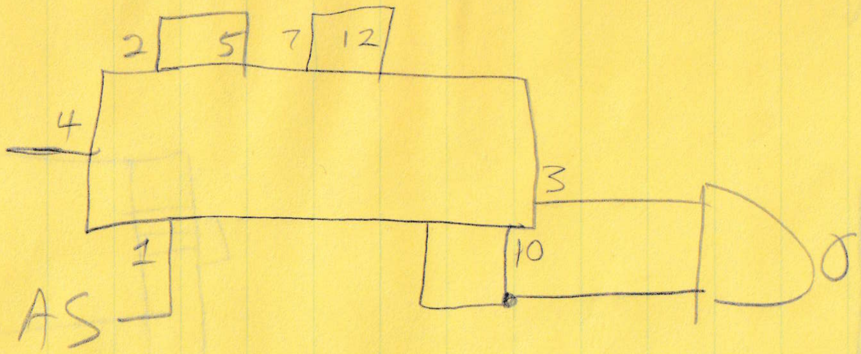
2907

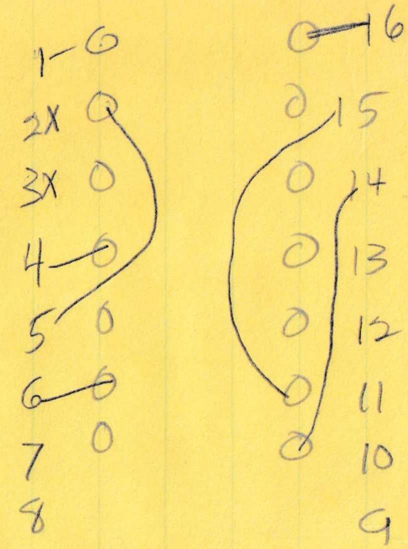
1	P	C	P	14
2	N	B	N	13
3	P	E	P	12
	X	X	X	
5	P	E	P	10
6	N	B	N	9
7	P	C	P	8

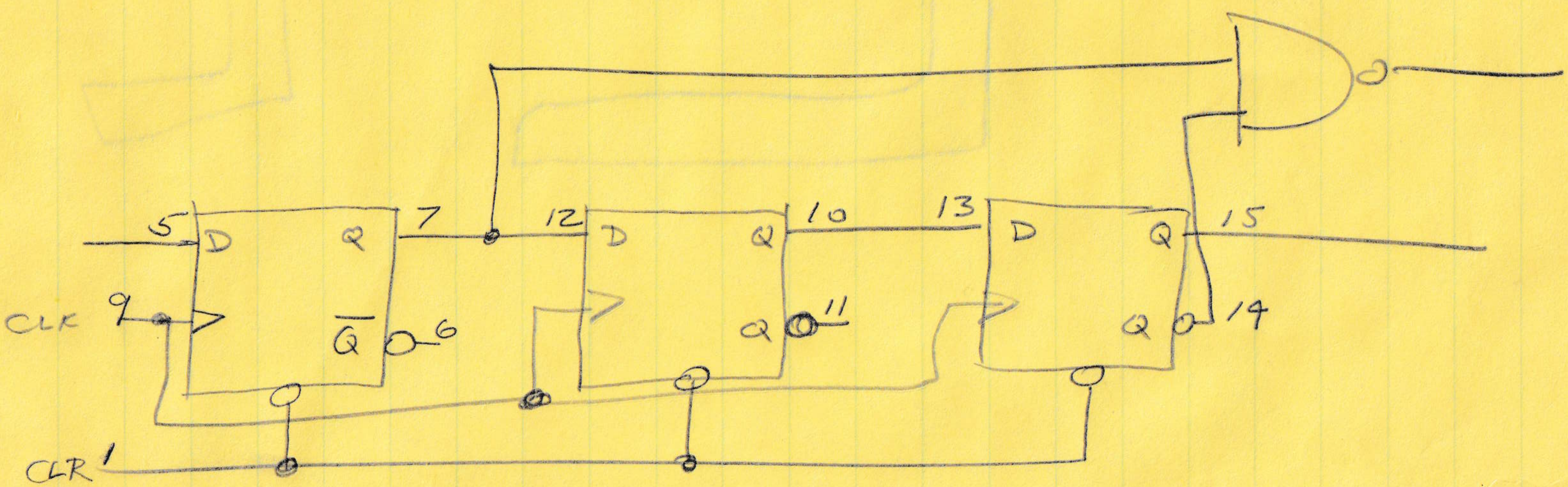
Digital Comb filt

LPF interpolator



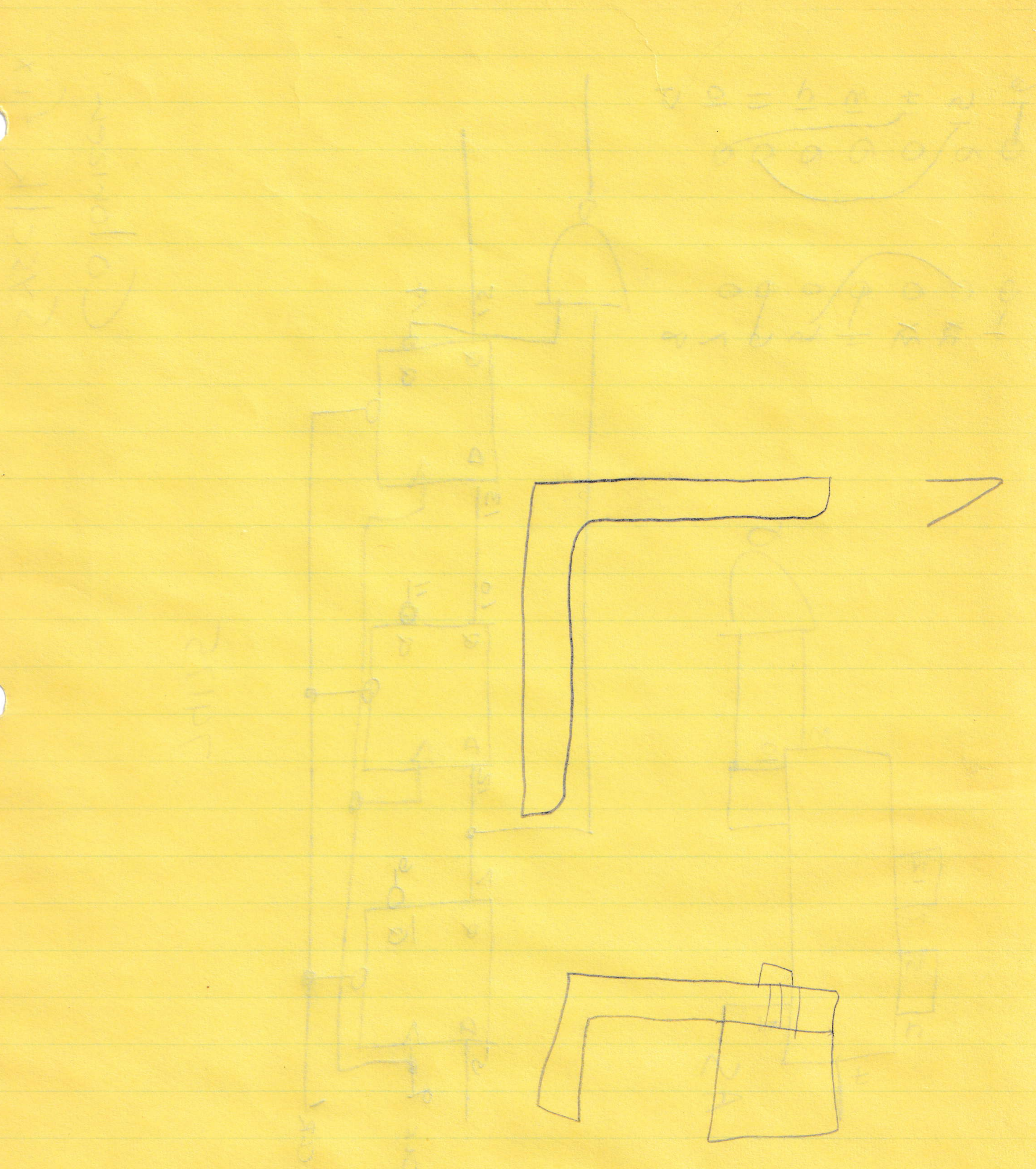




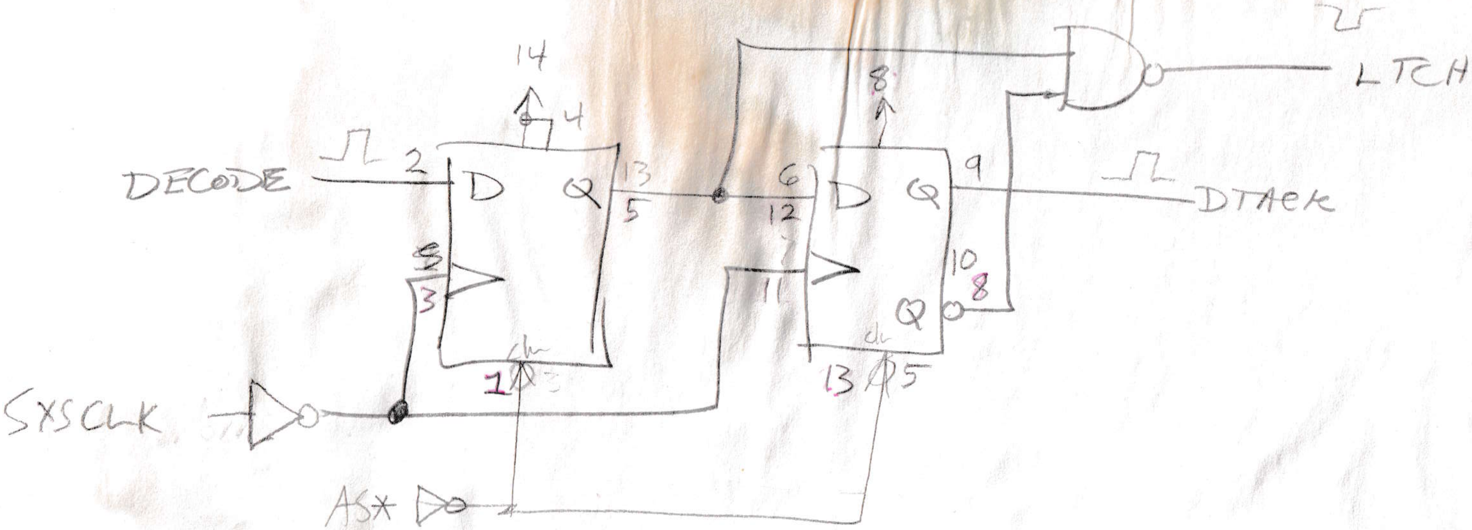


74175

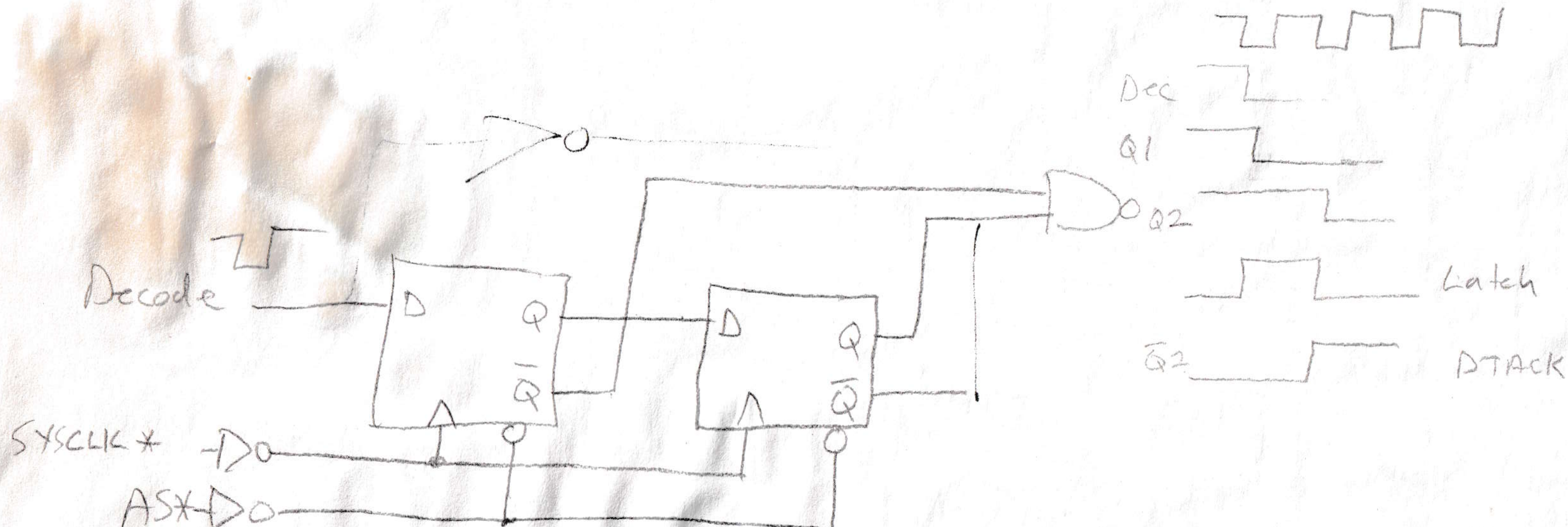
Colonizer
Sysclk fix



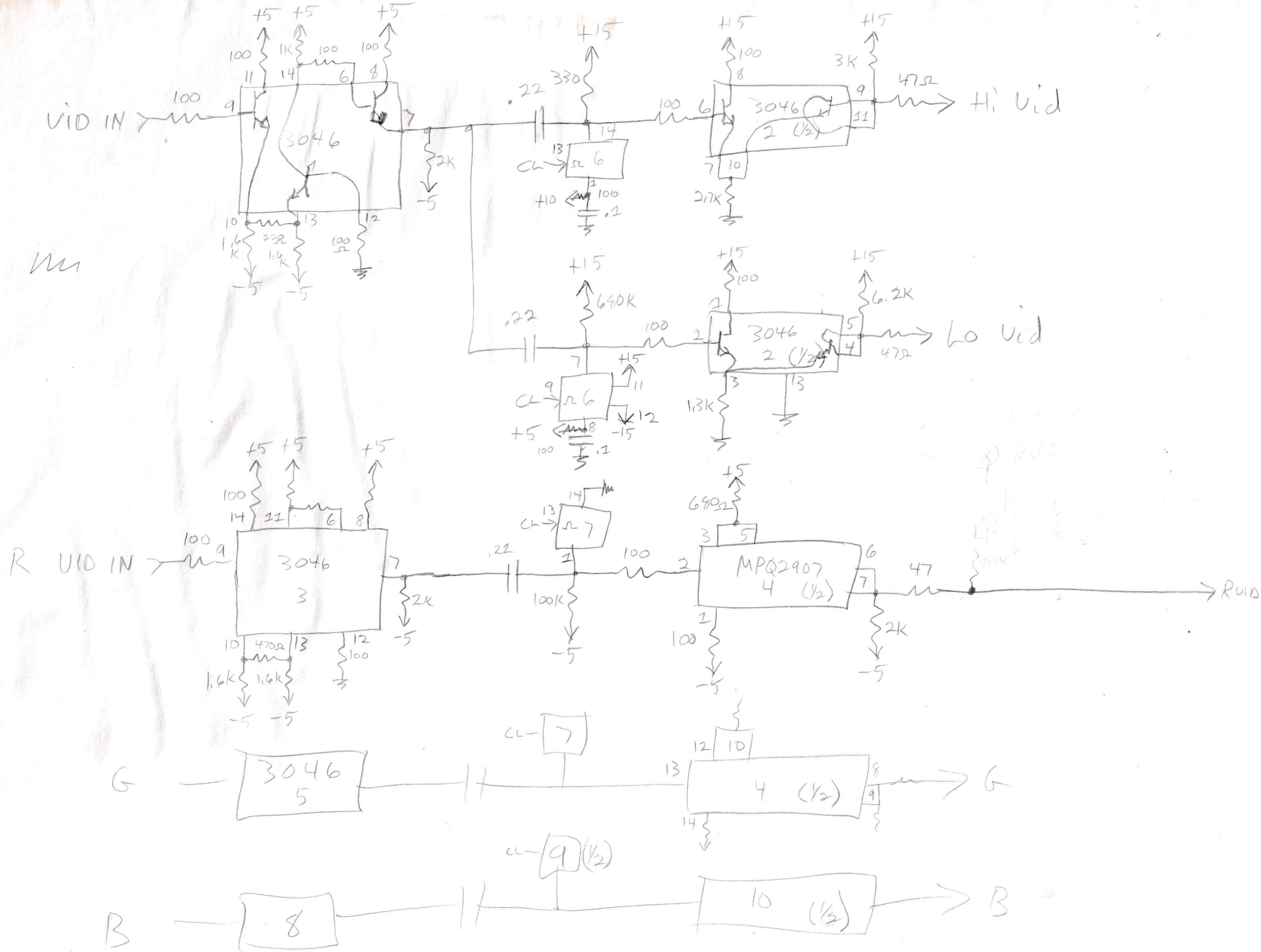
62.5ns pulse



DECODE
SYSCLK
AS*
LTCH
DTACK
D
Q

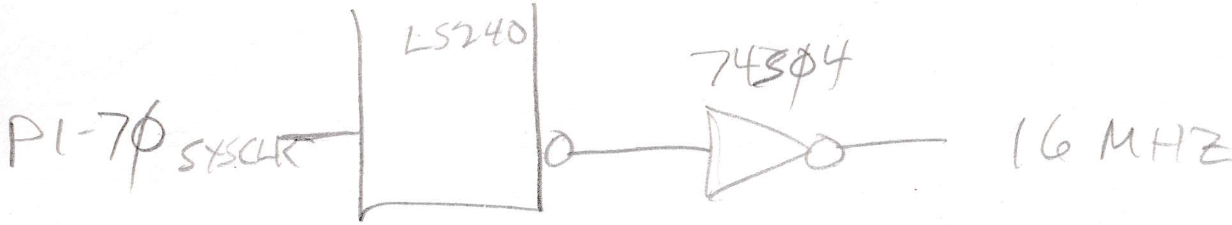


Decode
SYSCLK*
AS*
D
Q
Dec
Q1
Q2
Latch
DTACK


VID IN
3046
+5
100
1K
2K
-5
.22
330
+15
Hi Vid
47Ω
3K
2.7K
+10
.1
680K
6.2K
Lo Vid
1.3K
-15
R VID IN
3
470Ω
1.6K
100K
MPQ2907
4 (1/2)
680Ω
47
RVID
G
3046
5
CL
7
4 (1/2)
B
8
9 (1/2)
10 (1/2)

P 1

4th



P 5

Lower left

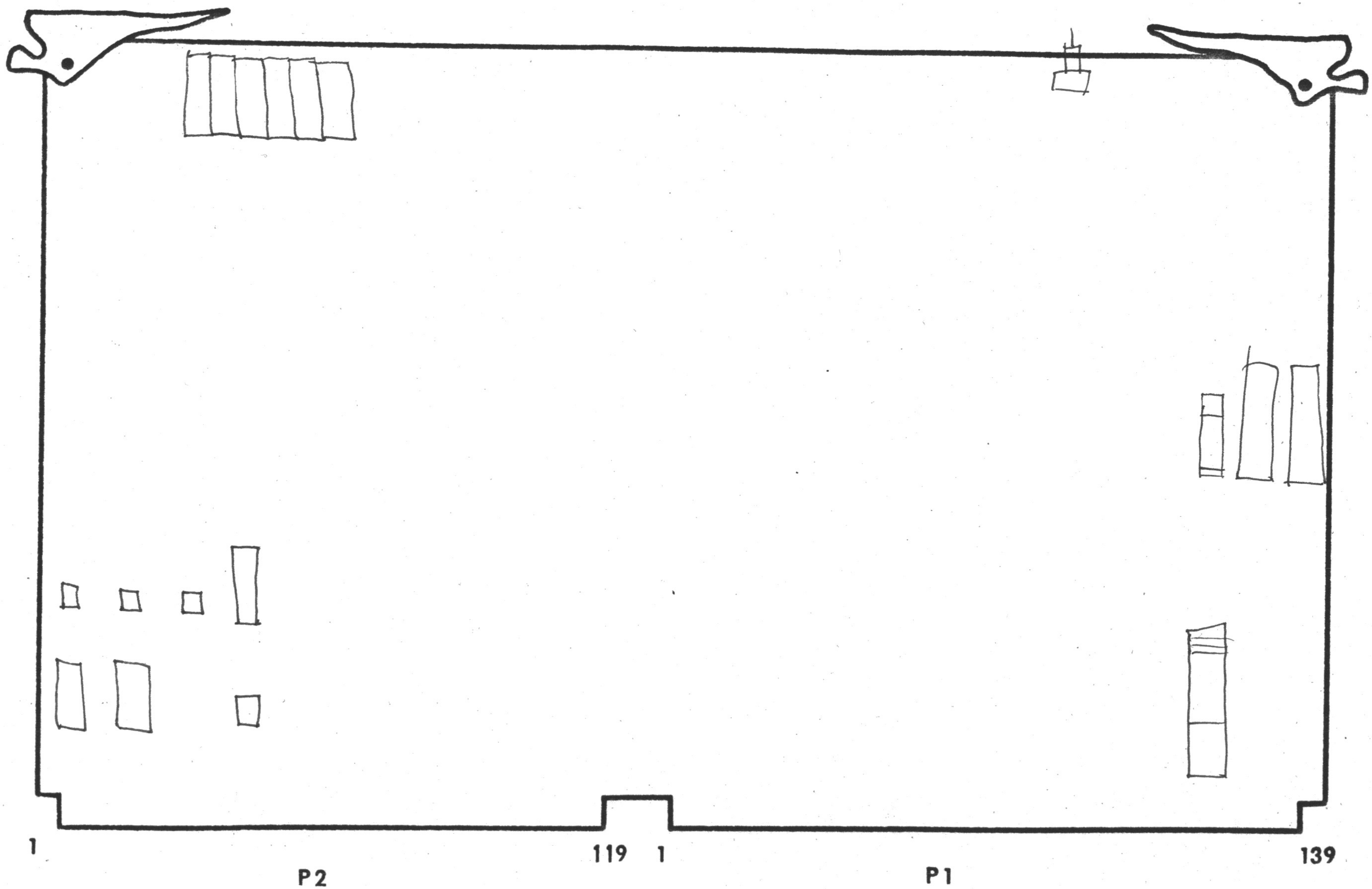
all "IO xxx chg to

RAM xxx

1uf 10v

BOARD ______________________ VER. ____________________

+15 - 600 ma
-15 - 500 ma



SLAVE HARDWARE DESCRIPTION   JANUARY 7, 1982
VECTOR CARD

ADDRESS BUS
- 0-2K SHARED & I/o
- 2K-4K window to Vector RAMS

B port
0004
4-7 @ PIA (2) SELECT
- 0 - Intensity
- 1 - Z stop
- 2 - Z start
- 3 - COM Z
- 4, 5 } U
- 6, 7 } 20

12 bits = POINTS

THERE ARE FOUR SETS OF RAMS TO HOLD THE X, Y, Z, AND INTENSITY FOR EACH VECTOR END POINT. EACH RAM SET WILL HOLD 512 VECTOR POINTS.

2048

THE RAM SETS FOR X, Y, AND Z:

START	STOP	START	STOP
8	8	4	4

START POINT 2	START POINT 1	END POINT 2	END POINT 1
START POINT 4	START POINT 3	END POINT 4	END POINT 3
START POINT 6	START POINT 5	END POINT 6	END POINT 5
.	.	.	.
.	.	.	.
.	.	.	.
START POINT N	START POINT N-1	END POINT N	END POINT N-1

6809

THE RAM SET FOR INTENSITY:

POINT 2	POINT 1
POINT 4	POINT 3
POINT 6	POINT 5
.	.
.	.
.	.
POINT N	POINT N-1

8 bits - INTENSITY
0 = OFF
1 = ON

VECTORS OFF <--> ON   0 - 4095

CONTROL REGISTER

BIT

ON PIA 3
- 5 - BLANKING   ENABLE/DISABLE
- 6 - INTENSITY ZERO BLANKING   ENABLE/DISABLE
- 7 - STOP COUNT BLANKING   ENABLE/DISABLE

(4)
- 1 PIA   12 Fade Bits
- 2 PIA   11 Start Address bits A + B_{0-2}
  RAM select B_{4-7}
- 3 PIA   Stop Address A + B_{0-2}

30 Hz
60 Hz   INTERRUPTS ON P.B.

DECODED AS REGULAR VERSABUS MEMORY

STANDARD ADDRESSING → BYTE ONLY ←

NO WORD OR LONG OPERATIONS

(2) Timer Chip

(1) DMA Chip

(5) DMA ADDRESS STROBE

52 lines

VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17		18	
19		20	
21		22	
23		24	
25		26	
27		28	
29		30	
31		32	
33		34	
35		36	
37		38	
39		40	
41		42	
43		44	
45		46	
47	V FADE IN	48	
49		50	
51	Z RAMP IN @	52	
53	VECTOR INT.OUT @	54	
55	X VECTOR OUT @	56	
57		58	
59	Y VECTOR OUT @	60	
61		62	
63	Z VECTOR OUT @	64	
65		66	
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane. ALL other pins are.

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

VVG

CORRECTIONS

```
1)  Problem: UA20 didin't get power and ground connections.

    Fix:     Jumper UA10-14 to UA20-14
             Jumper UA10-7  to UA20-7

2)  Problem: The clock and clear pins on UB16 and UB17 were reversed on
             the schematic.

    Fix:     Cut both wires by UB17-9 on solder side.
             Check between UC11-8 and UB17-9 for open.
             Check between UB16-9 and UB17-9 for open.
             Cut wire by UB16-12 on solder side.
             Check between UB15-9 and UB16-12 for open.
             Cut wire by UB17-12 on solder side.
             Check between UB11-3 and UB17-12 for open.

             Jumper UB17-12 to UB16-12
             Jumper UB16-12 to UC11-8
             Jumper UB16-9  to UB15-9
             Jumper UB17-9  to UB11-3

3)  Problem: The select line to UD12, UD13, and UD14 was incorrect.

    Fix:     Cut wire on RIGHT side of UD12-1 on solder side.
             Check between UD12-1 and UD11-2 for open.

             Jumper UA11-19 to UD24-5
             Jumper UD24-6  to UD14-1

4)  Problem: The direction control of the vector RAM tranceivers
             was incorrect.

    Fix:     Cut wire on RIGHT side of UA23-21 on solder side.
             Check between UA23-21 and UE14-1 for open.
             Cut wire by UD11-3 on component side.
             Check between UD11-3 and UE13-1 for open.
             Cut wire by UD11-3 on solder side.
             Check between UD11-3 and UE16-1 for open.
             Cut wire by UA24-21 on component side.
             Check between UA24-21 and UE19-1 for open.

             Jumper UA23-21 to UD11-3
             Jumper UD11-3  to UA24-21
             Jumper UE13-1  to UE16-1
             Jumper UD11-7  to UD24-9
             Jumper UD24-8  to UE20-1

5)  Problem: Multi-Wire mis-wired UA11-19 to UA13-11 instead of UA13-1.

    Fix:     Cut wire by UA13-11 on solder side.
             Check between UA13-11 and UA11-19 for open.

             Jumper UA11-19 to UA13-1

6)  Problem: SB_00 was decoded ase VB_DS0* instead of VB_DS1*.

    Fix:     Cut wire on BOTH sides of UC6-4
             Check between UC6-4 and UC5-3 for open.
             Check between UC6-4 and UB12-1 for open.

             Jumper UB12-1 to UC5-3
             Jumper UC5-5  to UC6-4
```

7) Problem: The DMA request latch needs a clear signal.

Fix: Jumper UA14-7 to UA8-2

8) Problem: The DMA_REQ* signal need to be enabled by E*.

Fix: Cut the wire by UA8-5 on solder side.
Check between UA8-5 and UA14-6 for open.

Jumper UB1-48 to UB12-13
Jumper UA14-6 to UB12-12
Jumper UB12-11 to UA8-5

9) Problem: Multi-Wire mis-wired LB_WR* to UB19-10 instead of VB_WR*.

Fix: Cut wire by UB19-10 on solder side.
Check between UB19-10 and UA10-6 for open.

Jumper UB19-10 to UC5-16

VVG Mods P3

1.- Ext. V Fade -

Remove UG5, Jumper UG5 pin 21 (comp side) to P2-47

2. H reset, not Z

Re-Jumper UC13 pin 5 to P2-77 (was 78)

3. Blkg change -

Cut trace on Back side going to P2-83. Jumper UB13-6 to P2-73.

VVG VECTOR GENERATOR

Reference No's	Total	Part Name	Part Type	Description
C1-2	2	C 100UF 20V TAN	CAPACITOR	100 UF 20V TANTALUM CAPACITOR
C3-7	5	C 47UF 20V TAN	CAPACITOR	47 UF 20V TANTALUM CAPACITOR
CA1-17,CB1-18,CC1-7, CD1-20,CE1-10, CF1-34,~~CG1-13~~ CG3-13	119	C .1UF 50V CER .25S	CAPACITOR	.1 UF 50V CERAMIC CAPACITOR
JB1	1	JB-14	JUMPER BLK	14 PIN JUMPER BLK
PB1	1	SW PB SPDT	SWITCH	SPDT PUSH-BUTTON SWITCH
RF1-2,4,6-7,9,11-12, 14,RG1-4	13	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
RF3,8,13	3	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
RF5,10,15	3	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
RPA1-3,RPC1-2	5	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
RVF1-6	6	RV 20K BOURNS 3006	POT	20K 3006 10 TURN PC POT 203
RVF7,RVG1-2	3	RV MFT ~~7014D~~ 7104D 419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
RVF8-10	3	RV 100K BOURNS 3006	POT	100K 3006 10 TURN PC POT 104
SUA1-2,22-24	5	DIP SOCKET-40 ST	SOCKET	40 PIN SOLDER TAIL DIP SOCKET
SUA3-6,11-12,15, SUB16-17,21-23, SUC1-10,SUD19-21, SUE1-21	46	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SUA7-10,13,16-17,20, SUB10-15,18,SUC11, 13,SUD22-24,26, SUF15-17,SUG1-2	26	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SUA14,SUB2-9,19, SUC12,SUD11-18,25	20	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SUA18-19,21	3	DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET
SUB1	1	DIP SOCKET-48 ST	SOCKET	48 PIN SOLDER TAIL DIP SOCKET (2-24 PIN)
SUB20,SUD1-10, SUF1-7	18	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SUF14,SUG3-4	3	RND SOCKET-10 ST	SOCKET	10 PIN SOLDER TAIL ROUND SOCKET
UA1	1	MC68B09	IC	2 MHZ 6809 MICRO-PROCESSOR

Reference No's	Total	Part Name	Part Type	Description
UA2	1	MC68B44	IC	2 MHZ TIMMER
UA3	1	74S244	IC	OCTAL BUS DRIVER
UA4,UB21,UE11-20	12	74LS245	IC	OCTAL BUS TRANCIEVER
UA5-6,UB22-23	4	74LS244	IC	OCTAL BUS DRIVER
UA7	1	74LS08	IC	QUAD 2-INPUT AND GATE
UA8,UD23	2	74LS00	IC	QUAD 2-INPUT NAND GATE
UA9,UB11,UC13,UD24	4	74LS04	IC	HEX INVERTER
UA10	1	74S00	IC	QUAD 2-INPUT NAND GATE
UA11-12,15,UC8-10, UD20-21	8	25LS2521	IC	8 BIT COMPARATOR
UA13,UB18	2	74LS11	IC	TRIPLE 3-INPUT AND GATE
UA14	1	74S188	IC	32X8 PROM
UA16,UB15	2	74LS10	IC	TRIPLE 3-INPUT NAND GATE
UA17,UB14	2	74LS20	IC	DUAL 4-INPUT NAND GATE
UA18-19	2	2716-25	IC	2KX8 EPROM - 250 ns
UA20,UB10	2	74S02	IC	QUAD 2-INPUT NOR GATE
UA21	1	MC68B40	IC	2 MHZ DMA CONTROLLER
UA22-24	3	MC68B21	IC	2 MHZ PIA
UB1	1	DP8408	IC	DYNAMIC RAM REFRESH CONTROLLER
UB2-9	8	MCM6665A-15	IC	150 ns 64K DYNAMIC RAM
UB12	1	74LS32	IC	QUAD 2-INPUT OR GATE
UB13	1	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
UB16-17	2	74S299	IC	8 BIT SHIFT REGISTER
UB19,UD15	2	74LS158	IC	QUAD 2-1 INV DATA MULTIPLEXERS
UB20,UD1-10	11	TMM2016	IC	2KX8 STATIC RAM
UC1,3,5-7	5	74LS240	IC	OCTAL BUS DRIVER
UC2,4	2	74S240	IC	OCTAL BUS DRIVER

Reference No's	Total	Part Name	Part Type	Description
UC11	1	30 MHZ OSC	OSCILLATOR	30 MHZ OSCILLATOR
UC12	1	74S161	IC	4-BIT COUNTER
UD11	1	74S153	IC	DUAL 4-1 DATA MULTIPLEXERS
UD12-14	3	74LS157	IC	QUAD 2-1 DATA MULTIPLEXER
UD16-18	3	74LS161	IC	4-BIT COUNTER
UD19,UE21	2	25LS2537	IC	4-10 LINE DECODER
UD22	1	74LS260	IC	DUAL 5-INPUT NOR GATE
UD25	1	74LS112	IC	DUAL J-K FLIP-FLOP
UD26	1	74LS86	IC	QUAD 2-INPUT EXOR GATE
UE1-10	10	74LS374	IC	OCTAL TRI-STATE REGISTER
UF1-7,UG5	8	HDH-1205	IC	FAST 12 BIT DAC
UF8-13	6	429B	IC	FAST ANALOG MULTIPLIER
UF14,UG3-4	3	AD533JH	IC	ANALOG MULTIPLIER
UF15-17,UG1-2	5	HA5195	IC	FAST OP AMP
UG6	1	LH0070	IC	PRECISION BCD REFERENCE

This file contains the programming for the address decoding PROM on the Vector Generator Board (VVG100A).

PROM-Adr	Data	Comments
00	FB	PIA 1 (FADE CONTROL)
01	FB	PIA 1 (FADE CONTROL)
02	F7	PIA 2 (START ADDRESS, RAM SELECT)
03	F7	PIA 2 (START ADDRESS, RAM SELECT)
04	EF	PIA 3 (STOP ADDRESS, CONTROL)
05	EF	PIA 3 (STOP ADDRESS, CONTROL)
06	FF	NOT USED
07	FF	NOT USED
08	FD	PTM
09	FD	PTM
0A	FD	PTM
0B	FD	PTM
0C	FF	NOT USED
0D	FF	NOT USED
0E	FF	NOT USED
0F	FF	NOT USED
10	FE	DMA CONTROLLER
11	FE	DMA CONTROLLER
12	FE	DMA CONTROLLER
13	FE	DMA CONTROLLER
14	FE	DMA CONTROLLER
15	FE	DMA CONTROLLER
16	FE	DMA CONTROLLER
17	FE	DMA CONTROLLER
18	FE	DMA CONTROLLER
19	FE	DMA CONTROLLER
1A	FE	DMA CONTROLLER
1B	FE	DMA CONTROLLER
1C	FF	NOT USED
1D	FF	NOT USED
1E	BF	DMA RESET
1F	DF	DMA REQUEST

```
P          ***********************************************************************************
P          *
P          * This code initializes the Vector Generator Board.
P          *
P          ***********************************************************************************
P          *
P          * These equates are the 6809's peripheral addresses
P          *
A   07C0   PIA1_DA  EQU      $07C0          PIA 1'S A DATA REGISTER
A   07C1   PIA1_CA  EQU      $07C1          PIA 1'S A CONTROL REGISTER
A   07C2   PIA1_DB  EQU      $07C2          PIA 1'S B DATA REGISTER
A   07C3   PIA1_CB  EQU      $07C3          PIA 1'S B CONTROL REGISTER
A   07C4   PIA2_DA  EQU      $07C4          PIA 2'S A DATA REGISTER
A   07C5   PIA2_CA  EQU      $07C5          PIA 2'S A CONTROL REGISTER
A   07C6   PIA2_DB  EQU      $07C6          PIA 2'S B DATA REGISTER
A   07C7   PIA2_CB  EQU      $07C7          PIA 2'S B CONTROL REGISTER
A   07C8   PIA3_DA  EQU      $07C8          PIA 3'S A DATA REGISTER
A   07C9   PIA3_CA  EQU      $07C9          PIA 3'S A CONTROL REGISTER
A   07CA   PIA3_DB  EQU      $07CA          PIA 3'S B DATA REGISTER
A   07CB   PIA3_CB  EQU      $07CB          PIA 3'S B CONTROL REGISTER
A   07D0   PTM_C13  EQU      $07D0          PTM'S CONTROL REGISTERS 1 AND 3
A   07D1   PTM_C2   EQU      $07D1          PTM'S CONTROL REGISTER 2
A   07D2   PTM_TMR1 EQU      $07D2          PTM'S TIMER 1
A   07D4   PTM_TMR2 EQU      $07D4          PTM'S TIMER 2
A   07D6   PTM_TMR3 EQU      $07D6          PTM'S TIMER 3
A   07E0   DMA_ADR  EQU      $07E0          DMA'S ADDRESS HIGH REGISTER
A   07E2   DMA_BCNT EQU      $07E2          DMA'S BYTE COUNT HIGH REGISTER
A   07F0   DMA_CHAN EQU      $07F0          DMA'S CHANNEL CONTROL
A   07F4   DMA_PRI  EQU      $07F4          DMA'S PRIORITY CONTROL
A   07F5   DMA_INTR EQU      $07F5          DMA'S INTERRUPT CONTROL
A   07F6   DMA_DC   EQU      $07F6          DMA'S DATA CHAIN CONTROL
A   07FC   DMA_CLR  EQU      $07FC          DMA REQUEST CLEAR PULSE
A   07FE   DMA_REQ  EQU      $07FE          DMA REQUEST SET PULSE
A   1000   PRAM_BASE EQU     $1000          BASE OF PROCESSOR RAM
A   0800   VRAM_BASE EQU     $0800          BASE OF VECTOR RAM
A   0FFF   VRAM_TOP EQU      $0FFF          TOP OF VECTOR RAM
P          *
P          *** VECTOR RAM BANK NUMBERS
P          *
A   0000   VRAM_INT EQU      0              INTENSITY BANK NUMBER
A   0001   VRAM_Z2  EQU      1              Z ENDING VALUE LSB BANK NUMBER
A   0002   VRAM_Z1  EQU      2              Z BEGINNING VALUE LSB BANK NUMBER
A   0003   VRAM_Z3  EQU      3              Z BEGIN/END VALUE'S MSB BANK NUMBER
A   0004   VRAM_Y2  EQU      4              Y ENDING VALUE LSB BANK NUMBER
A   0005   VRAM_Y1  EQU      5              Y BEGINNING VALUE LSB BANK NUMBER
A   0006   VRAM_Y3  EQU      6              Y BEGIN/END VALUE'S MSB BANK NUMBER
A   0007   VRAM_X2  EQU      7              X ENDING VALUE LSB BANK NUMBER
A   0008   VRAM_X1  EQU      8              X BEGINNING VALUE LSB BANK NUMBER
A   0009   VRAM_X3  EQU      9              X BEGIN/END VALUE'S MSB BANK NUMBER
P          *
P          * MISC EQUATES
P          *
A   00AF   EN_INTR  EQU      $AF            CLEARS FIRQ* AND IRQ* MASK BITS
A   0050   MSK_INTR EQU      $50            SETS FIRQ* AND IRQ* MASK BITS
A   0000   MAIL_FLG EQU      $0000          MAIL FLAG ADDRESS
A   0003   DMA_RCMD EQU      $03            DMA READ COMMAND (MEMORY TO VRAM)
A   0002   DMA_WCMD EQU      $02            DMA WRITE COMMAND (VRAM TO MEMORY)
P          *
```

```
P                    * EXTERNAL DEFINITIONS
P                    *
P                              XDEF     START                 EXPORT PROGRAM START
P                              XDEF     DMA_READ              EXPORT DMA READ ROUTINE
P                              XDEF     DMA_WRT               EXPORT DMA WRITE ROUTINE
P                    *
P                              XREF     TST_PRAM              PROCESSOR RAM TEST
P                              XREF     TST_SRAM              SHARED RAM TEST
P                              XREF     TST_VRAM              VECTOR RAM TEST
P                              XREF     TST_DMA               DMA TEST
P                              XREF     PTRN1TBL              TEST PATTERN TABLE
P                    *
P                    * PROGRAM START
P                    *
P                              PSCT                           PROGRAM SECTION
P                    *
P                    *** RESERVE SPACE FOR CHECK SUM VALUE
P                    *
P 0000 0000          CHK_SUM   FDB      0000                  RESERVE 2 BYTES FOR CHECK SUM
P                    *
P      0002          START     EQU      *                     START OF PROGRAM
P 0002 86F0                    LDA      #$F0                  INITIALIZATION IN PROGRESS FLAG
P 0004 9700                    STA      MAIL_FLG              STORE IN MAIL FLAG
P 0006 10CE0400                LDS      #H_STACK              TOP OF HARDWARE STACK
P 000A CE0800                  LDU      #U_STACK              TOP OF USER STACK
P 000D BD0000                  JSR      TST_PRAM              TEST PROCESSOR RAM
P 0010 BD0027                  JSR      PIA_INIT              INITIALIZE PIA'S REGISTERS
P 0013 BD0000                  JSR      TST_SRAM              TEST SHARED RAM
P 0016 BD0000                  JSR      TST_VRAM              TEST VECTOR RAM
P 0019 BD0050                  JSR      DMA_INIT              INITIALIZE DMA CONTROLLER
P 001C BD0000                  JSR      TST_DMA               TEST DMA CHANNEL
P 001F BD00BA                  JSR      PTRN_INI              INITIALIZE PATTERN IN VECTOR RAMS
P 0022 8600                    LDA      #$00                  INIT COMPLETE, ALL OK FLAG
P 0024 9700                    STA      MAIL_FLG              STORE IN MAIL FLAG
P 0026 13                      SYNC                           ROAD BLOCK
P                    *
P                    * SUBROUTINE TO INITALIZE THE PIA'S REGISTERS
P                    *
P      0027          PIA_INIT EQU       *                     ENTRY
P 0027 86FF                    LDA      #$FF                  ALL OUTPUTS ON PIAS 1,2 AND 3
P 0029 B707C0                  STA      PIA1_DA               PIA 1, PORT A
P 002C B707C2                  STA      PIA1_DB               PIA 1, PORT B
P 002F B707C4                  STA      PIA2_DA               PIA 2, PORT A
P 0032 B707C6                  STA      PIA2_DB               PIA 2, PORT B
P 0035 B707C8                  STA      PIA3_DA               PIA 3, PORT A
P 0038 B707CA                  STA      PIA3_DB               PIA 3, PORT B
P                    *
P 003B 8604                    LDA      #$04                  OUTPUT REG ACCESS ONLY
P 003D B707C1                  STA      PIA1_CA               PIA 1, PORT A
P 0040 B707C3                  STA      PIA1_CB               PIA 1, PORT B
P 0043 B707C5                  STA      PIA2_CA               PIA 2, PORT A
P 0046 B707C7                  STA      PIA2_CB               PIA 2, PORT B
P 0049 B707C9                  STA      PIA3_CA               PIA 3, PORT A
P 004C B707CB                  STA      PIA3_CB               PIA 3, PORT B
P 004F 39                      RTS                            RETURN
P                    *
P                    * SUBROUTINE TO INITIALIZE DMA CONTROLLER
P                    *
```

```
P      0050    DMA_INIT EQU     *                 ENTRY
P 0050 B607FC           LDA     DMA_CLR           CLEAR REQUEST LATCH
P 0053 8601             LDA     #$01              ENABLE REQ0 ONLY
P 0055 B707F4           STA     DMA_PRI           STORE IN PRIORITY REGISTER
P 0058 8600             LDA     #$00              NO INTERRUPTS
P 005A B707F5           STA     DMA_INTR          STORE IN INTERRUPT REGISTER
P 005D 8600             LDA     #$00              2 CHANNEL, NO DATA CHAIN
P 005F B707F6           STA     DMA_DC            STORE IN DATA CHAIN REGISTER
P 0062 39               RTS                       DONE
P                  *
P                  *** SUBROUTINE TO DO DMA TRANSFERS
P                  *
P      0063    DMA_TRNS EQU     *                 ENTRY
P 0063 B707F0           STA     DMA_CHAN          STORE READ OR WRITE COMMAND
P 0066 BF07E0           STX     DMA_ADR           STORE STARTING ADDRESS
P 0069 3706             PULU    D                 GET BYTE COUNT FROM STACK
P 006B FD07E2           STD     DMA_BCNT          STORE BYTE COUNT
P                  *
P 006E B607FE           LDA     DMA_REQ           REQUEST DMA
P 0071 B607F0  DMA_TRN1 LDA     DMA_CHAN          WAIT TO COMPLETE
P 0074 8580             BITA    #$80              COMPLETE BIT SET ?
P 0076 27F9             BEQ     DMA_TRN1          LOOP IF NOT SET
P                  *
P 0078 39               RTS                       DONE
P                  *
P                  * SUBROUTINE TO DO DMA READ TRANSFERS
P                  *
P      0079    DMA_READ EQU     *                 ENTRY
P 0079 8603             LDA     #DMA_RCMD         GET DMA READ COMMAND (MEMORY TO VRAM)
P 007B BD0063           JSR     DMA_TRNS          DO DMA TRANSFER
P 007E 39               RTS                       DONE
P                  *
P                  * SUBROUTINE TO DO DMA WRITE TRANSFERS
P                  *
P      007F    DMA_WRT  EQU     *                 ENTRY
P 007F 8602             LDA     #DMA_WCMD         GET DMA WRITE COMMAND (MEMORY TO VRAM)
P 0081 BD0063           JSR     DMA_TRNS          DO DMA TRANSFER
P 0084 39               RTS                       DONE
P                  *
P                  *** ROUTINE TO OUTPUT BEGIN OR END ADDRESSES
P                  *
P      0085    SET_ADR  EQU     *
P 0085 E781             STB     ,X++              STORE LSB OF BEGIN ADDRESS, POINT TO DB
P 0087 E684             LDB     ,X                GET DATA PORT B
P 0089 C4F8             ANDB    #$F8              SAVE TOP (BANK SELECT)
P 008B 8407             ANDA    #$07              MAKE SURE MSB OF BEGIN VALID
P 008D 3602             PSHU    A                 SAVE MSB OF BEGIN
P 008F EAC0             ORB     ,U+               OR IN MSB OF BEGIN
P 0091 E784             STB     ,X                PUT IT BACK
P 0093 39               RTS
P                  *
P                  *** ROUTINE TO SET VECTOR BEGINNING ADDRESS
P                  *
P      0094    SET_BGN  EQU     *                 ENTRY
P 0094 8E07C4           LDX     #PIA2_DA          GET ADDRESS OF BEGIN PIA
P 0097 BD0085           JSR     SET_ADR           SET THE ADDRESS
P 009A 39               RTS
P                  *
```

```
P                 *** ROUTINE TO SET VECTOR ENDING ADDRESS
P                 *
P       009B      SET_END  EQU    *                 ENTRY
P 009B 8E07C8              LDX    #PIA3_DA          GET ADDRESS OF BEGIN PIA
P 009E BD0085              JSR    SET_ADR           SET THE ADDRESS
P 00A1 39                  RTS
P                 *
P                 *** ROUTINE TO SET VECTOR FADE VALUE
P                 *
P       00A2      SET_FADE EQU    *                 ENTRY
P 00A2 F707C0              STB    PIA1_DA           SAVE LSB OF FADE VALUE
P 00A5 B707C2              STA    PIA1_DB           SAVE MSB OF FADE VALUE
P 00A8 39                  RTS
P                 *
P                 *** ROUTINE TO OUTPUT BANK ADDRESSES
P                 *
P       00A9      SET_BANK EQU    *
P 00A9 48                  LSLA                     BANK ADDRESS -
P 00AA 48                  LSLA                     GOES IN TOP 4 -
P 00AB 48                  LSLA                     BITS OF THE -
P 00AC 48                  LSLA                     PIA
P 00AD F607C6              LDB    PIA2_DB           GET DATA PORT B
P 00B0 C40F                ANDB   #$0F              SAVE BOTTOM (MSB OF START)
P 00B2 3602                PSHU   A                 SAVE BANK ADDRESS
P 00B4 EAC0                ORB    ,U+               OR IN BANK ADDRESS
P 00B6 F707C6              STB    PIA2_DB           PUT IT BACK
P 00B9 39                  RTS
P                 *
P                 *** ROUTINE TO INITIALIZE PATTERN RAMS WITH TEST PATTERN
P                 *
P       00BA      PTRN_INI EQU    *                 ENTRY
P 00BA CC0000              LDD    #0000             START AT BOTTOM
P 00BD 318DFF3F            LEAY   PTRN1TBL,PCR      GET TABLE ADDRESS
P 00C1 BD00DD              JSR    TRNS_VR           TRANSFER DATA
P 00C4 CC0000              LDD    #0000             STARTING ADDRESS
P 00C7 BD0094              JSR    SET_BGN           SET BEGINNING ADDRESS
P 00CA 318DFF32            LEAY   PTRN1TBL,PCR      GET TABLE ADDRESS
P 00CE ECA4                LDD    ,Y                GET BYTE COUNT
P 00D0 830001              SUBD   #1                -1
P 00D3 BD009B              JSR    SET_END           SET ENDING ADDRESS
P 00D6 CCFFFF              LDD    #$FFFF            TURN ON OUTPUT
P 00D9 BD00A2              JSR    SET_FADE          SET FADE VALUE
P 00DC 39                  RTS                      DONE
P                 *
P                 *** ROUTINE TO OUTPUT A TABLE OF DATA TO THE VECTOR RAMS
P                 *
P       00DD      TRNS_VR  EQU    *                 ENTRY
P 00DD 3606                PSHU   D                 SAVE OUTPUT BEGIN ADDRESS
P 00DF B607C6              LDA    PIA2_DB           GET MSB OF OLD START AND BANK
P 00E2 F607C4              LDB    PIA2_DA           GET LSB OF OLD START
P 00E5 3406                PSHS   D                 SAVE FOR RESTORE
P 00E7 3706                PULU   D                 GET NEW ADDRESS
P 00E9 BD0094              JSR    SET_BGN           SET DMA BEGIN ADDRESS
P 00EC ECA1                LDD    ,Y++              GET BYTE COUNT OF TABLES
P 00EE 3406                PSHS   D                 SAVE IT
P       00F0      TRNS_VR1 EQU    *
P 00F0 AEA1                LDX    ,Y++              GET STARTING ADDRESS
P 00F2 2712                BEQ    TRNS_VR2          DONE WHEN ADDRESS IS ZERO
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```
P 00F4 A6A0                LDA    ,Y+              GET BANK NUMBER
P 00F6 3620                PSHU   Y                SAVE POINTER
P 00F8 BD00A9              JSR    SET_BANK         SET THE BANK NUMBER
P 00FB ECE4                LDD    ,S               GET BYTE COUNT
P 00FD 3606                PSHU   D                SAVE FOR TRANSFER ROUTINE
P 00FF BD0079              JSR    DMA_READ         TRANSFER DATA
P 0102 3720                PULU   Y                GET BACK TABLE POINTER
P 0104 20EA                BRA    TRNS_VR1         LOOP
P      0106      TRNS_VR2  EQU    *
P 0106 3262                LEAS   2,S              LOSE BYTE COUNT
P 0108 3506                PULS   D                GET BACK OLD ADDRESS
P 010A B707C6              STA    PIA2_DB          RESTORE MSB OF OLD START AND BANK
P 010D F707C4              STB    PIA2_DA          RESTORE LSB OF OLD START
P 0110 39                  RTS                     DONE
P                *
P                * THIS IS THE INTERRUPT VECTOR TABLE
P                *
A      FFF0                ORG    $FFF0            START OF INTERRUPT TABLE
A                *
A FFF0 0002                FDB    START            RESERVED INTERRUPT
A FFF2 0002                FDB    START            SOFTWARE INTERRUPT 3    (SWI3)
A FFF4 0002                FDB    START            SOFTWARE INTERRUPT 2    (SWI2)
A FFF6 0002                FDB    START            FAST INTERRUPT REQUEST  (FIRQ*)
A FFF8 0002                FDB    START            INTERRUPT REQUEST       (IRQ*)
A FFFA 0002                FDB    START            SOFTWARE INTERRUPT      (SWI)
A FFFC 0002                FDB    START            NON-MASKABLE INTERRUPT  (NMI*)
A FFFE 0002                FDB    START            RESET VECTOR            (RESET*)
A                *
D                          DSCT                    DATA SECTION (RAM)
D                *
D 0000 0400                RMB    $400             1K FOR HARDWARE STACK
D      0400      H_STACK   EQU    *                TOP OF HARDWARE STACK
D 0400 0400                RMB    $400             1K FOR USER STACK
D      0800      U_STACK   EQU    *                TOP OF USER STACK
D                *
D                          END

***** TOTAL ERRORS       0--    0
***** TOTAL WARNINGS     0--    0
```

FILE: "VERSEFX" PAGE: 1

START (0-4096)			END (0-4096)			(0-255)	
X	Y	Z	X	Y	Z	Int.	Notes
0	0	2047	200	3600	2047	255	V
500	3600		200	3600		75	
500	3600		700	0		255	
500	0		700	0		50	
500	0		350	2800		150	
200	0		350	2800		150	
200	0	2047	0	0	2047	50	
Repeat 7	Repeat 7	0	Repeat 7	Repeat 7	0	Repeat 7	
0	0	2047	0	0	0	127	
200	3600		200	3600			
500	3600		500	3600			
700	0		700	0			
500	0		500	0			
350	2800		350	2800			
200	0	2047	200	0	0	127	
700	1600	2047	700	3600	2047	127	E
1100	3600		700	3600		100	
1100	3600		1100	3200		25	
800	3200		1100	3200		75	
800	3200		800	2800		25	
1000	2800		800	2800		50	
1000	2800		1000	2400		25	
800	2400		1000	2400		50	
800	2400		800	2000		25	
1100	2000		800	2000		75	
1100	2000		1100	1600		25	
700	1600	2047	1100	1600	2047	100	
Repeat 12	Repeat 12	0	Repeat 12	Repeat 12	0	Repeat 12	
700	1600	2047	700	1600	0	127	
700	3600		700	3600			
1100	3600		1100	3600			
1100	3200		1100	3200			
800	3200		800	3200			
800	2800		800	2800			
1000	2800		1000	2800			
1000	2400		1000	2400			
800	2400		800	2400			
800	2000		800	2000			
1100	2000		1100	2000			
1100	1600	2047	1100	1600	0	127	

FILE: Versefx PAGE: 2

START (0-4096)			END (0-4096)			(0-255)	
X	Y	Z	X	Y	Z	Int.	Notes
1200	1600	2047	1200	3600	2047	127	R
1300	3600		1200	3600		25	
1300	3600		1300	2800		50	
1350	2800		1300	2800		17	
1350	2400		1450	3600		60	
1550	3600		1450	3600		25	
1550	3600		1450	2800		60	
1550	2400		1450	2800		35	
1550	2400		1550	2000		25	
1450	1600		1550	2000		35	
1450	1600	2047	1200	1600	2047	60	
Repeat 11	Repeat 11	0	Repeat 11	Repeat 11	0	Repeat 11	
1200	1600	2047	1200	1600	0	127	
1200	3600		1200	3600			
1300	3600		1300	3600			
1300	2800		1300	2800			
1350	2800		1350	2800			
1450	3600		1450	3600			
1550	3600		1550	3600			
1450	2800		1450	2800			
1550	2400		1550	2400			
1550	2000		1550	2000			
1450	1600	2047	1450	1600	0	127	
2000	2000	2047	1900	1600	2047	35	S
1800	1600		1900	1600		25	
1800	1600		1700	2000		35	
1700	2400		1700	2000		25	
1700	2400		1800	2800		35	
1900	2800		1800	2800		25	
1900	2800		1900	3200		25	
1800	3200		1900	3200		25	
1800	3200		1750	3000		25	
1700	3200		1750	3000		25	
1700	3200		1800	3600		35	
1900	3600		1800	3600		25	
1900	3600		2000	3200		35	
2000	2800		2000	3200		25	
2000	2800		1900	2400		35	
1800	2400		1900	2400		25	
1800	2400		1800	2000		25	

FILE: versefx PAGE: 3

START (0-4096)			END (0-4096)			(0-255)	
X	Y	Z	X	Y	Z	Int.	Notes
1900	2000	2047	1800	2000	2047	25	
1900	2000		1950	2200		25	
2000	2000	2047	1950	2200	2047	25	
Repeat 20	Repeat 20	0	Repeat 20	Repeat 20	0	Repeat 20	
2000	2000	2047	2000	2000	0	127	
1900	1600		1900	1600			
1800	1600		1800	1600			
1700	2000		1700	2000			
1700	2400		1700	2400			
1800	2800		1800	2800			
1900	2800		1900	2800			
1900	3200		1900	3200			
1800	3200		1800	3200			
1750	3000		1750	3000			
1700	3200		1700	3200			
1800	3600		1800	3600			
1900	3600		1900	3600			
2000	3200		2000	3200			
2000	2800		2000	2800			
1900	2400		1900	2400			
1800	2400		1800	2400			
1800	2000		1800	2000			
1900	2000		1900	2000			
1950	2200	2047	1950	2200	0	127	
2100	800	2047	2100	3600	2047	200	E
2500	3600		2100	3600		100	
2500	3600		2500	3200		25	
2200	3200		2500	3200		75	
2200	3200		2200	2400		50	
2400	2400		2200	2400		50	
2400	2400		2400	2000		25	
2200	2000		2400	2000		50	
2200	2000		2200	1200		50	
2500	1200		2200	1200		75	
2500	1200		2500	800		25	
2100	800	2047	2500	800	2047	100	
Repeat 12	Repeat 12	0	Repeat 12	Repeat 12	0	Repeat 12	
2100	800	2047	2100	800	0	127	
2100	3600		2100	3600			
2500	3600		2500	3600			

FILE: Versefx PAGE: 4

START (0-4096)			END (0-4096)			(0-255)	
X	Y	Z	X	Y	Z	Int.	Notes
2500	3200	2047	2500	3200	0	127	
2200	3200		2200	3200			
2200	2400		2200	2400			
2400	2400		2400	2400			
2400	2000		2400	2000			
2200	2000		2200	2000			
2200	1200		2200	1200			
2500	1200		2500	1200			
2500	800	2047	2500	800	0	127	
2600	800	2047	2600	3600	2047	200	F
2700	3600		2600	3600		25	
2700	3600		2700	2400		75	
2900	2400		2700	2400		50	
2900	2400		2900	2000		25	
2700	2000		2900	2000		50	
2700	2000		2700	1200		50	
3000	1200		2700	1200		75	
3000	1200		3000	800		25	
2600	800	2047	3000	800	2047	100	
Repeat10	Repeat10	0	Repeat10	Repeat10	0	Repeat10	
2600	800	2047	2600	800	0	127	
2600	3600		2600	3600			
2700	3600		2700	3600			
2700	2400		2700	2400			
2900	2400		2900	2400			
2900	2000		2900	2000			
2700	2000		2700	2000			
2700	1200		2700	1200			
3000	1200		3000	1200			
3000	800	2047	3000	800	0	127	
3100	800	2047	3275	2200	2047	100	X
3100	3600		3275	2200		100	
3100	3600		3200	3600		25	
3325	2700		3200	3600		75	
3325	2700		3450	3600		75	
3550	3600		3450	3600		25	
3550	3600		3375	2200		100	
3550	800		3375	2200		100	
3550	800		3450	800		25	
3325	1700		3450	800		75	

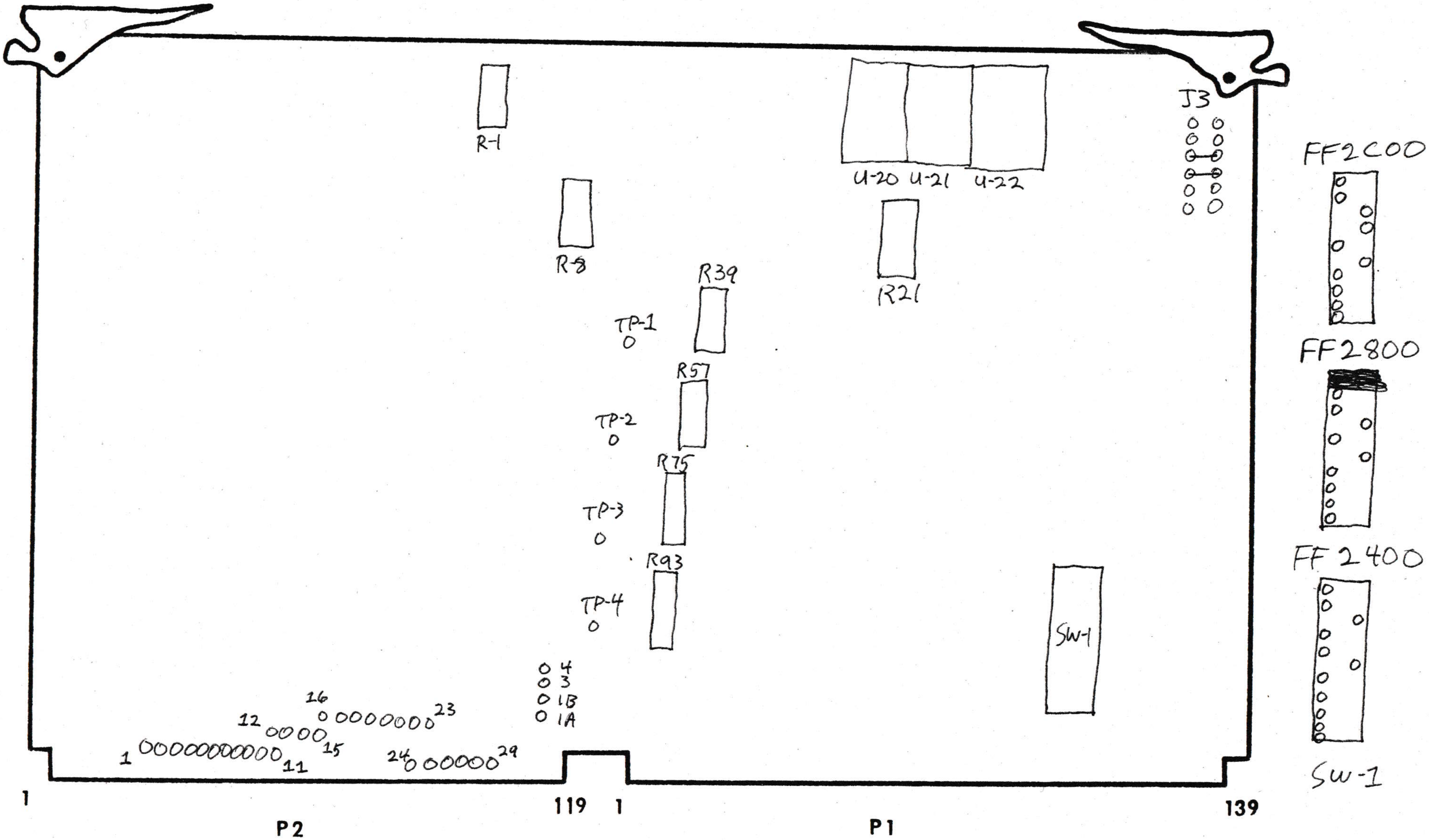
FILE: Versefx PAGE: 5

START (0-4096)			END (0-4096)			(0-255)	
X	Y	Z	X	Y	Z	Int.	Notes
3325	1700	2047	3200	800	2047	75	
3100	800	2047	3200	800	2047	25	
Repeat 12	Repeat 12	0	Repeat 12	Repeat 12	0	Repeat 12	
3100	800	2047	3100	800	0	127	
3275	2200		3275	2200			
3100	3600		3100	3600			
3200	3600		3200	3600			
3325	2700		3325	2700			
3450	3600		3450	3600			
3550	3600		3550	3600			
3375	2200		3375	2200			
3550	800		3550	800			
3450	800		3450	800			
3325	1700		3325	1700			
3200	800	2047	3200	800	0	127	

BOARD VAO

VER. 100A

+15 300 ma
-15 500 ma



THERE ARE SIXTEEN OSCILLATORS, EACH HAVING THE FOLLOWING PARAMETERS:

	OFFSET
OFFSET	0 - 4095
GAIN	0 - 4095
FREQUENCY	0 - 4095
PHASE LOCK POINT	0 - 4095
OFFSET MODULATION SOURCE	0 - 31
GAIN MODULATION SOURCE	0 - 31
PHASE LOCK SELECT	0 - 31

CONTROL REGISTERS

BITS		
0 - 3	PHASE LOCK MULTIPLE	0 - 15
4 & 5	WAVEFORM SELECT	0 - 3
6	OFFSET FULL WAVE RECTIFIER	ON/OFF
7	GAIN FULL WAVE RECTIFIER	ON/OFF

OSC1 - FF2400
OSC2 - FF2800
OSC3 - FF2C00

VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17	AB1	18	
19	AB2	20	
21	AB3	22	
23	AB4	24	
25	AB5	26	
27	AB6	28	
29	AB7	30	
31	AB8	32	
33	AB9	34	
35	AB10	36	
37	AB11	38	AB17
39	AB12	40	AB18
41	AB13	42	AB19
43	AB14	44	AB20
45	AB15	46	AB21
47	AB16	48	AB22
49		50	AB23
51		52	AB24
53		54	AB25
55		56	AB26
57		58	AB27
59		60	AB28
61		62	AB29
63		64	AB30
65		66	AB31
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane. ALL other pins are.

AB1 - AB31 ANALOG BUS LINES

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

ANALOG BUS

#	P-2#	DESCRIPTION	REMARKS	
0	n/a	GND (off)	TO MINIMIZE CROSSTALK	
1	17	DSP (sin)		
2	19	DSP (cos)	BOARD #1	
3	21	HFO		
4	23	HFO		
5	25	DSP (sin)		
6	27	DSP (cos)	BOARD #2	
7	29	HFO		
8	31	HFO		UNIQUE TO A
9	33	DSP (sin)		SLAVE CHANNEL
10	35	DSP (cos)	BOARD #3	
11	37	HFO		
12	39	HFO		
13	41	VERT RAMP	FROM VTB	
14	43	HORIZ. RAMP	FROM VTB	
15	45	Z RAMP	FROM VTB	
16	47	CHANNEL SPARE		
17	38	DSP (sin)		
18	40	DSP (cos)	BOARD #1*	
19	42	HFO		
20	44	HFO		
21	46	DSP (sin)		
22	48	DSP (cos)	BOARD #2*	
23	50	HFO		
24	52	HFO		SHARED BY ALL
25	54	EXT IN #1	REAR PANEL	CHANNELS
26	56	EXT IN #2	REAR PANEL	
27	58	EXT IN #3	REAR PANEL	
28	60	VID IN #1	FROM ROUTING	
29	62	VID IN #2	FROM ROUTING	
30	64	VID IN #3	FROM ROUTING	
31	66	VID IN #4	FROM ROUTING	

DSP = DIGITAL SLAVED PAIR OSCILLATOR
HFO = HIGH FREQUENCY OSCILLATOR

* BOARDS TO BE LOCATED IN MASTER CHASSIS

```
VAO       SETUP


---VAO ON EXTENDER


DIGITAL OSCILLATORS:

         FF2400 =     0        FF2420 =   0
         FF2402 =    10        FF2422 =   0
         FF2408 =   7FF        FF2428 =   2
         FF240A =   FFF  X ampl
         FF240C =   7FF
         FF240E =   FFF

         ---CENTER ALL DIP POTS.
         ---SCOPE TP-3, VERIFY SINE WAVE; SAME AT TP-4.
         ---SET FF240E = 7FF, ADJ R75-B FOR AC NULL TP-3.
            SET R75-C FOR ZERO VOLTS.
         ---SET FF240A = 7FF, ADJ R93-B FOR AC NULL, TP-4.
            SET R93-C FOR ZERO VOLTS.
         ---SET 0A, 0E TO FFF, SET 20 + 22 TO 8080.
         ---SET R75-D FOR ZERO VOLTS AT BOTTOM OF FULL WAVE RECTIFIED SINE
            WAVE AT TP-3.
         ---SET R93-D FOR ZERO AT TP-4 AS SHOWN.


ANALOG OSCILLATORS:

         FF2410 =   7FF        FF2424 =     0
         FF2412 =   FFF        FF2426 =     0
         FF2414 =   7FF        FF242A =   101
         FF2416 =   FFF
         FF2418 =   FFF
         FF241A =   FFF

         ---DVM PIN 8 U-35, SET R8-D FOR 6.5 VOLTS.
         ---DVM PIN 8 U-31, SET R8-A FOR 6.5 VOLTS.
            VERIFY    45us SINE WAVE AT TP-1 + 2.
         ---SET FF2412 = 7FF, 16 = 7FF.
         ---SCOPE TP-1, SET R39-B FOR AC NULL, R39-C, ZERO DC.
         ---SCOPE TP-2, SET R57-B FOR AC NULL, R57-C, ZERO DC.

         FF2412 = FFF          FF2424 = 8080
         FF2416 = FFF          FF2426 = 8080
         FF2418 =    0         FF242A =  101
         FF2418 =    0
         FF241A =    0

         ---SET R39-D FOR BOTTOM OF FWR SINE WAVE TO ZERO VOLTS AT TP-1.
         ---SET R57-D FOR BOTTOM OF FWR SINE WAVE TO ZERO AT TP-2.
         ---SET FF2428 TO 1100.  ADJUST R8-B FOR 0 TO +10V TRIANGLE AT TP-1.
            ADJUST R1 FOR 0 TO +10V TRIANGLE AT TP-2.
         ---SET 28 TO 2200.  ADJUST R1-C FOR 0 TO +10 SQUARE AT TP-2.
            ADJUST R8-C FOR 0 TO +10 SQUARE AT TP1.
```

CONNECT OSC 1-4 OUT TO AB PADS ACCORDING TO CHART:

ANALOG BUS #'S 16 17 18 19 20 21 22 23 P2

12 13 14 15

1 2 3 4 5 6 7 8 9 10 11 24 25 26 27 28 29

OSC	MASTER CHASSIS		RESCAN CHASSIS		
1A	#17	#21	#1	#5	#9
1B	#18	#22	#2	#6	#10
3	#19	#23	#3	#7	#11
4	#20	#24	#4	#8	#12
	BOARD 1	BOARD 2	BOARD 1	BOARD 2	BOARD 3
	FF2400	FF2800	FF2400	FF2800	FF2C00

Initialization Table for: VAO #3 TEST PGM L1

Base = FF2C00

00	0	20	0	40	60	80	A0	C0	E0
02	1	22	0	42	62	82	A2	C2	E2
04		24	0	44	64	84	A4	C4	E4
06		26	0	46	66	86	A6	C6	E6
08	7FF	28	2	48	68	88	A8	C8	E8
0A		2A	101	4A	6A	8A	AA	CA	EA
0C		2C		4C	6C	8C	AC	CC	EC
0E		2E		4E	6E	8E	AE	CE	EE
10		30		50	70	90	B0	D0	F0
12		32		52	72	92	B2	D2	F2
14		34		54	74	94	B4	D4	F4
16		36		56	76	96	B6	D6	F6
18		38		58	78	98	B8	D8	F8
1A	7FF	3A		5A	7A	9A	BA	DA	FA
1C		3C		5C	7C	9C	BC	DC	FC
1E		3E		5E	7E	9E	BE	DE	FE

Base =

00	20	40	60	80	A0	C0	E0
02	22	42	62	82	A2	C2	E2
04	24	44	64	84	A4	C4	E4
06	26	46	66	86	A6	C6	E6
08	28	48	68	88	A8	C8	E8
0A	2A	4A	6A	8A	AA	CA	EA
0C	2C	4C	6C	8C	AC	CC	EC
0E	2E	4E	6E	8E	AE	CE	EE
10	30	50	70	90	B0	D0	F0
12	32	52	72	92	B2	D2	F2
14	34	54	74	94	B4	D4	F4
16	36	56	76	96	B6	D6	F6
18	38	58	78	98	B8	D8	F8
1A	3A	5A	7A	9A	BA	DA	FA
1C	3C	5C	7C	9C	BC	DC	FC
1E	3E	5E	7E	9E	BE	DE	FE

Initialization Table for: VAO #1 TEST PGM L1

Base = FF2400

00	0	20	0	40	60	80	A0	C0	E0
02	1	22	0	42	62	82	A2	C2	E2
04		24	0	44	64	84	A4	C4	E4
06		26	0	46	66	86	A6	C6	E6
08	7FF	28	2	48	68	88	A8	C8	E8
0A	7FF	2A	101	4A	6A	8A	AA	CA	EA
0C		2C		4C	6C	8C	AC	CC	EC
0E		2E		4E	6E	8E	AE	CE	EE
10		30		50	70	90	B0	D0	F0
12		32		52	72	92	B2	D2	F2
14		34		54	74	94	B4	D4	F4
16		36		56	76	96	B6	D6	F6
18		38		58	78	98	B8	D8	F8
1A	7FF	3A		5A	7A	9A	BA	DA	FA
1C		3C		5C	7C	9C	BC	DC	FC
1E		3E		5E	7E	9E	BE	DE	FE

Base = FF2800 VAO #2

00	0	20	0	40	60	80	A0	C0	E0
02	1	22	0	42	62	82	A2	C2	E2
04		24	0	44	64	84	A4	C4	E4
06		26	0	46	66	86	A6	C6	E6
08	7FF	28	2	48	68	88	A8	C8	E8
0A		2A	101	4A	6A	8A	AA	CA	EA
0C		2C		4C	6C	8C	AC	CC	EC
0E		2E		4E	6E	8E	AE	CE	EE
10		30		50	70	90	B0	D0	F0
12		32		52	72	92	B2	D2	F2
14		34		54	74	94	B4	D4	F4
16		36		56	76	96	B6	D6	F6
18		38		58	78	98	B8	D8	F8
1A	7FF	3A		5A	7A	9A	BA	DA	FA
1C		3C		5C	7C	9C	BC	DC	FC
1E		3E		5E	7E	9E	BE	DE	FE

*** IMPORTANT!!! MUST BE DONE BEFORE FIRING UP VAO-100A! ***

*PROBLEM: P1 +5 AND GND CONNECTED BY PCS.

SOLUTION: CUT BETWEEN PIN 1 + 3 COMP SIDE P1. ALSO CUT NEAR C42 LEGEND AS SHOWN:

```
                                        |
         ...............................|                    X = CUT
        /  .......................  ....|
       / /                    XXX       |      <---CUT
      / /  ...................  | |     | U-95
     O/---|    C 42    |---|O|          |
          |............|                |
     ..............................     |
     |        U-94          |
     |                      |
```

*PROBLEM: -15 CONNECTED TO PIN 7 OF U-32 + 34.

SOLUTION: CUT OLD CONNECTION TO PIN 7, JUMPER PIN 7 TO PIN 10, BOTH IC'S.

*PROBLEM: SPARE DECODER ENABLED INSTEAD OF OSCILLATOR 3 + 4.

SOLUTION: RE-BURN FROM U-77.

*PROBLEM: C15 AND C12 STUFFED WITH 1000 INSTEAD OF 100pf.

SOLUTION: REPLACE WITH 100pf.

*PROBLEM: SHORT ON BOARD NEAR BOTTOM U-58.

SOLUTION: EXACTO!

```
          |          |
          |   U-58   |        ||
          |__________|        ||
                             //
               ||           //
               ||          O
                \\        xxx <---SHORT
                 \\==============\\
                                  \\
```

*PROBLEM: RANGE OF HFOSC.

SOLUTION: CHANGE VALUES: R14, R15 = 3.9K; C11, C16 = 2000pf.
NOTE: ON REV A BOARDS, PARALLEL 1000pf FROM ABOVE WITH EXISTING 1000pf.

*PROBLEM: INVERTED BITS 4 + 12 TO MUX REGS.

SOLUTION: MAKE 2 CUTS BY U-4 & U-8:

```
                                                                     X = CUT
                                     |
|         |         |         |      |    |         |         |         |
|         |         |         |      |    |         |____     |         |
|   U-3   |         |   U-4   |      |    |   U-8   |    \____|   U-9   |
|         |         |         |      |    |         |____     |         |
|_________|         |_________|      |    |         |    X____| <--CUT  |
        CUT--->                      |    |         |____     |         |
      O-------X-----------------     |    |         |    \____|         |
         O--------------------       |    |_________|         |_________|
            O-------------           |
               O------------         |            COMP SIDE
                                     |
```

---JUMPER U-91 - 5 TO U-81 - 3.
---JUMPER U-81 - 4 TO U-4 - 8.
---JUMPER U-92 - 5 TO U-81 - 9.
---JUMPER U-81 - 8 TO U-8 - 8.

*PROBLEM: COMPONENT VALUE CHANGE.

SOLUTION: CHANGE R51 AND R33 TO 3.9K.

*PROBLEM: PAL OUTPUTS LEFT OFF BY PCS.

SOLUTION: JUMPER U-64 - 1 TO U-77 - 6;
--JUMPER U-64 - 2 TO U-29 - 6;
--JUMPER U-64 - 3 TO U-29 - 8.

*PROBLEM: CARRY IN WAS TIED TO +5, NOT TO GND.

SOLUTION: CUT TRACE U-37 - 7; JUMPER U-37 - 7 TO U-37 - 8.

*PROBLEM: EPROM SELECTS NOT CONNECTED BY PCS.

SOLUTION: JUMPER U-20, U-21, U-22, PIN 1 TO PIN 28.
EX: U-20 - 1 TO U-20 - 28.

VAO VAO

Component List for VA0100A

Reference No's	Total	Part Name	Part Type	Description
C6-7	2	C .01UF 50V CER T.S.	CAPACITOR	.01 UF TEMP STABLE CERAMIC CAPACITOR
C11-12, 15-16	2 ~~4~~	C ~~1000PF~~ 2000PF CER T.S.	CAPACITOR	1000 PF TEMP. STABLE CERAMIC CAPACITOR
	2	C 100PF CER T.S.	''	100 PF '' '' ''
C13-14-C43	2	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
CR1-~~15~~ 16	15	1N914	DIODE	SWITCHING DIODE
R1, 8, 21, 39, 57, 75, 93	7	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R2, 4	2	R 18M OHM 1/4W 2%	No description found in cross ref file	
R3, 5	2	R 3.9M OHM 1/4W 2%	No description found in cross ref file	
R6-7	2	R 3.3K OHM 1/4W 2%	No description found in cross ref file	
R9-11, 13-19, 22-26, 28, 30-35, 37, 40-44, 46, 48-53, 55, 58-62, 64, 66-71, 73, 76-80, 82, 84-89, 91	62	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R12, 20	2	R 82K OHM 1/4W 2%	No description found in cross ref file	
R27, 29, 36, 38, 45, 47, 54, 56, 63, 65, 72, 74, 81, 83, 90, 92	16	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
RP1, 2, 3	~~1~~ 3	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
SW1	1	SW DIP-10	No description found in cross ref file	
U1-8, 11-12, 16-17, 36, 38, 57	15	74LS377	IC	OCTAL REGISTER WITH ENABLE
U9	1	74LS138	IC	3-TO-8 LINE DECODER
U10, 30	2	HI518	No description found in cross ref file	
U13, 15	2	74LS169	No description found in cross ref file	
U14, 64	2	PAL10L8	No description found in cross ref file	
U18, 40-41	3	74LS244	IC	OCTAL BUS DRIVER
U19, 23	2	DAC-80	IC	12 BIT DAC WITH OP AMP
U20-22	3	2764	No description found in cross ref file	
U24-27, 42-45, 67-70, 83-86	16	HI506	IC	16X1 ANALOG SW
U28-29, 81	3	74LS04	IC	HEX INVERTER

OAV OQV

Change C15, C12 = 100pf certs
change C11, C16 = 2000pf certs

Component List for VA0100A

Reference No's	Total	Part Name	Part Type	Description
U31,35	2	ICL8038	No description found in cross ref file	
U32,34,46,59,71,87	6	AH0134	IC	DUAL ANALOG SWITCH
U33,47-48,60-61, 72-73,88-89	9	LF347	No description found in cross ref file	
U37,39,53,55,58,65	6	74LS283	No description found in cross ref file	
U49,62,74,90	4	AD533JH	IC	ANALOG MULTIPLIER
U50,75-76	3	AD390	No description found in cross ref file	
U51-52	2	74LS139	IC	DUAL 2-4 LINE DECODER
U54,56,66,78	4	74LS273	No description found in cross ref file	
U63	1	74LS00	IC	QUAD 2-INPUT NAND GATE
U77,98	2	27S28	No description found in cross ref file	
U79	1	74LS32	IC	QUAD 2-INPUT OR GATE
U80	1	74LS164	IC	8 BIT SERIAL IN/ PARALLEL OUT REGISTER
U82	1	74LS08	IC	QUAD 2-INPUT AND GATE
U91-93,95	4	74LS240	IC	OCTAL BUS DRIVER
U94	1	74LS74A	IC	DUAL D FLIP-FLOP
U96-97	2	25LS2521	IC	8 BIT COMPARATOR
U99	1	74LS02	IC	QUAD 2-INPUT NOR GATE
U100	1	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT

TC-204535

Stuffing List for VA0100A

Reference No's	Part Name	Part Type	Description
C1	Reference not found in component list		
C2	Reference not found in component list		
C3	Reference not found in component list		
C4	Reference not found in component list		
C5	Reference not found in component list		
C6-7	C .01UF 50V CER T.S.	CAPACITOR	.01 UF TEMP STABLE CERAMIC CAPACITOR
C8	Reference not found in component list		
C9	Reference not found in component list		
C10	Reference not found in component list		
C11-16	C 2000PF CER T.S.	CAPACITOR	1000 PF TEMP. STABLE CERAMIC CAPACITOR
C13-14 C15,C12	C 100pf " " C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
C15-16	C 1000PF CER T.S.	CAPACITOR	1000 PF TEMP. STABLE CERAMIC CAPACITOR
C44	47uf 20v		
CR1-15	1N914	DIODE	SWITCHING DIODE
R1	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R2	R 18M OHM 1/4W 2%	No description found in cross ref file	
R3	R 3.9M OHM 1/4W 2%	No description found in cross ref file	
R4	R 18M OHM 1/4W 2%	No description found in cross ref file	
R5	R 3.9M OHM 1/4W 2%	No description found in cross ref file	
R6-7	R 3.3K OHM 1/4W 2%	No description found in cross ref file	
R8	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R9-11	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R12	R 82K OHM 1/4W 2%	No description found in cross ref file	
R13-19	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R20	R 82K OHM 1/4W 2%	No description found in cross ref file	
R21	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R22-26	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R27	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R28	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R29	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R30-35	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R36	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R37	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R38	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R39	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R40-44	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R45	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R46	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R47	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R48-53	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R54	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R55	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R56	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R57	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R58-62	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R63	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R64	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R65	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R66-71	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R72	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR

Reference No's	Part Name	Part Type	Description
R73	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R74	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R75	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
R76-80	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R81	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R82	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R83	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R84-89	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R90	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R91	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R92	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R93	RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K
RP1	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
SW1	SW DIP-10	No description found in cross ref file	
U1-8	74LS377	IC	OCTAL REGISTER WITH ENABLE
U9	74LS138	IC	3-TO-8 LINE DECODER
U10	HI518	No description found in cross ref file	
U11-12	74LS377	IC	OCTAL REGISTER WITH ENABLE
U13	74LS169	No description found in cross ref file	
U14	PAL10L8	No description found in cross ref file	
U15	74LS169	No description found in cross ref file	
U16-17	74LS377	IC	OCTAL REGISTER WITH ENABLE
U18	74LS244	IC	OCTAL BUS DRIVER
U19	DAC-80	IC	12 BIT DAC WITH OP AMP
U20-22	2764	No description found in cross ref file	
U23	DAC-80	IC	12 BIT DAC WITH OP AMP
U24-27	HI506	IC	16X1 ANALOG SW
U28-29	74LS04	IC	HEX INVERTER
U30	HI518	No description found in cross ref file	
U31	ICL8038	No description found in cross ref file	
U32	AH0134	IC	DUAL ANALOG SWITCH
U33	LF347	No description found in cross ref file	
U34	AH0134	IC	DUAL ANALOG SWITCH
U35	ICL8038	No description found in cross ref file	
U36	74LS377	IC	OCTAL REGISTER WITH ENABLE
U37	74LS283	No description found in cross ref file	
U38	74LS377	IC	OCTAL REGISTER WITH ENABLE
U39	74LS283	No description found in cross ref file	
U40-41	74LS244	IC	OCTAL BUS DRIVER
U42-45	HI506	IC	16X1 ANALOG SW
U46	AH0134	IC	DUAL ANALOG SWITCH
U47-48	LF347	No description found in cross ref file	
U49	AD533JH	IC	ANALOG MULTIPLIER
U50	AD390	No description found in cross ref file	
U51-52	74LS139	IC	DUAL 2-4 LINE DECODER
U53	74LS283	No description found in cross ref file	
U54	74LS273	No description found in cross ref file	

Reference No's	Part Name	Part Type	Description
U55	74LS283	No description found in cross ref file	
U56	74LS273	No description found in cross ref file	
U57	74LS377	IC	OCTAL REGISTER WITH ENABLE
U58	74LS283	No description found in cross ref file	
U59	AH0134	IC	DUAL ANALOG SWITCH
U60-61	LF347	No description found in cross ref file	
U62	AD533JH	IC	ANALOG MULTIPLIER
U63	74LS00	IC	QUAD 2-INPUT NAND GATE
U64	PAL10L8	No description found in cross ref file	
U65	74LS283	No description found in cross ref file	
U66	74LS273	No description found in cross ref file	
U67-70	HI506	IC	16X1 ANALOG SW
U71	AH0134	IC	DUAL ANALOG SWITCH
U72-73	LF347	No description found in cross ref file	
U74	AD533JH	IC	ANALOG MULTIPLIER
U75-76	AD390	No description found in cross ref file	
U77	27S28	No description found in cross ref file	
U78	74LS273	No description found in cross ref file	
U79	74LS32	IC	QUAD 2-INPUT OR GATE
U80	74LS164	IC	8 BIT SERIAL IN/ PARALLEL OUT REGISTER
U81	74LS04	IC	HEX INVERTER
U82	74LS08	IC	QUAD 2-INPUT AND GATE
U83-86	HI506	IC	16X1 ANALOG SW
U87	AH0134	IC	DUAL ANALOG SWITCH
U88-89	LF347	No description found in cross ref file	
U90	AD533JH	IC	ANALOG MULTIPLIER
U91-93	74LS240	IC	OCTAL BUS DRIVER
U94	74LS74A	IC	DUAL D FLIP-FLOP
U95	74LS240	IC	OCTAL BUS DRIVER
U96-97	25LS2521	IC	8 BIT COMPARATOR
U98	27S28	No description found in cross ref file	
U99	74LS02	IC	QUAD 2-INPUT NOR GATE
U100	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT

OSCILLATOR BOARD ADDRESSES

BASE ADDRESS +			
ØØØØ	(ØØ,Ø1)	LOAD DIGITAL △ REG LOW 16 BITS	(BYTES OK)
ØØØ1	(Ø2,Ø3)	LOAD DIGITAL △ REG HIGH 8 BITS	(BYTES OK)
ØØØ2	(Ø4,Ø5)	LOAD WAVEFORM RAM LOW 16 BITS	(BYTES OK)
ØØØ3	(Ø6,Ø7)	LOAD WAVEFORM RAM HIGH 8 BITS	(BYTES OK)
ØØØ4	(Ø8,Ø9)	LOAD DOSC 1A OFFSET DAC	(WORD ONLY)
ØØØ5	(ØA,ØB)	LOAD DOSC 1A AMPLITUDE DAC	(WORD ONLY)
ØØØ6	(ØC,ØD)	LOAD DOSC 1B OFFSET DAC	(WORD ONLY)
ØØØ7	(ØE,ØF)	LOAD DOSC 1B AMPLITUDE DAC	(WORD ONLY)
ØØØ8	(1Ø,11)	LOAD AOSC 1 OFFSET DAC	(WORD ONLY)
ØØØ9	(12,13)	LOAD AOSC 1 AMPLITUDE DAC	(WORD ONLY)
ØØØA	(14,15)	LOAD AOSC 2 OFFSET DAC	(WORD ONLY)
ØØØB	(16,17)	LOAD AOSC 2 AMPLITUDE DAC	(WORD ONLY)
ØØØC	(18,19)	LOAD AOSC 1 FREQUENCY DAC	(WORD ONLY)
ØØØD	(1A,1B)	LOAD AOSC 2 FREQUENCY DAC	(WORD ONLY)
ØØØE	(1C,1D)	SPARE DAC	(WORD ONLY)
ØØØF	(1E,1F)	SPARE DAC	(WORD ONLY)
ØØ1Ø	(2Ø,21)	DOSC 1A ANALOG BUS SEL [redacted]	(BYTES OK)
ØØ11	(22,23)	DOSC 1B ANALOG BUS SEL [redacted]	(BYTES OK)
ØØ12	(24,25)	AOSC 1 ANALOG BUS SEL	(BYTES OK)
ØØ13	(26,27)	AOSC 2 ANALOG BUS SEL	(BYTES OK)
ØØ14	(28,29)	MODE SELECTS FOR DOSC 2	(BYTES OK)
ØØ15	(2A,2B)	AOSC 1 & 2 CONTROLS 0101	(BYTES OK)
ØØ16		NOT USED	
ØØ17		NOT USED	
↓		NOT USED	
ØØ1F		NOT USED	

WORD FORMATS

ALL DACS — LOW 12 BITS INTO DAC

BUS SELS —

0							7	8							15
OFF0	OFF1	OFF2	OFF3	OFF4	X	X	OFWR	AMP0	AMP1	AMP2	AMP3	AMP4	X	X	AFWR

MODE WORD —

0							7	8							15
DOSC MD0	DOSC MD1	DOSC MD2	X	WAV0	WAV1	X	X	AOSC1 WAV	WAV1	WAV2	X	AOSC2 WAV	WAV1	WAV2	X

OSC3+4 CONTROL

0							7	8							15
LOW RANGE	RST EN	RST EN	X	HDIV0	HDIV1	HDIV2	HDIV3	LOW RANGE	RST EN	RST EN	X	HDIV0	HDIV1	HDIV2	HDIV3

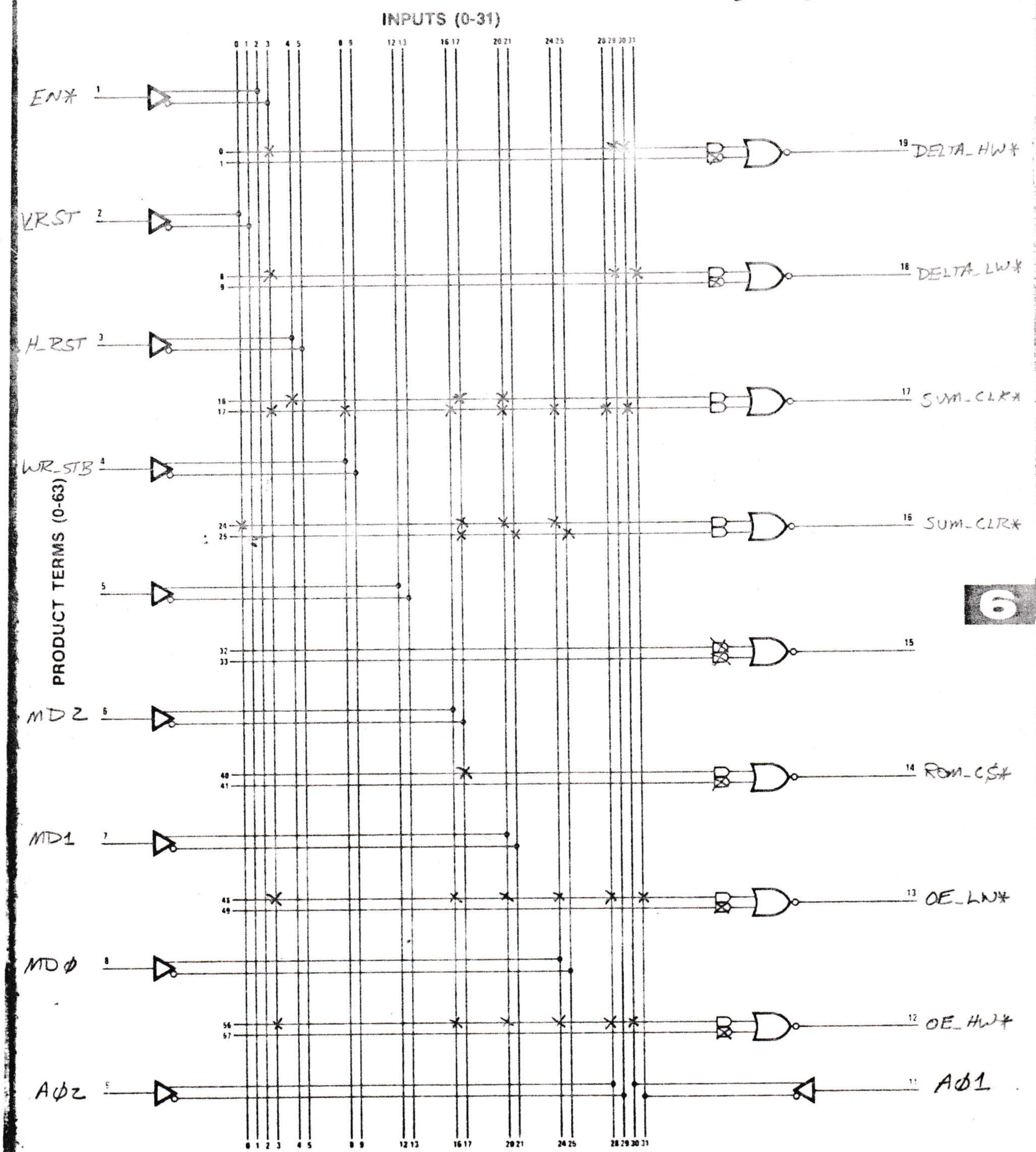
AOSC1 AOSC2

Digital Oscillator Function Decoding

VA0

3/16/83

Logic Diagram PAL10L8



6

Programming Format

PAL10L8

PATTERN: Digital Osc Func Decode

NAME: Bob Ritchey

DATE: 3/16/83

PRODUCT TERMS (0-63)

INPUTS (0-31)

VAO

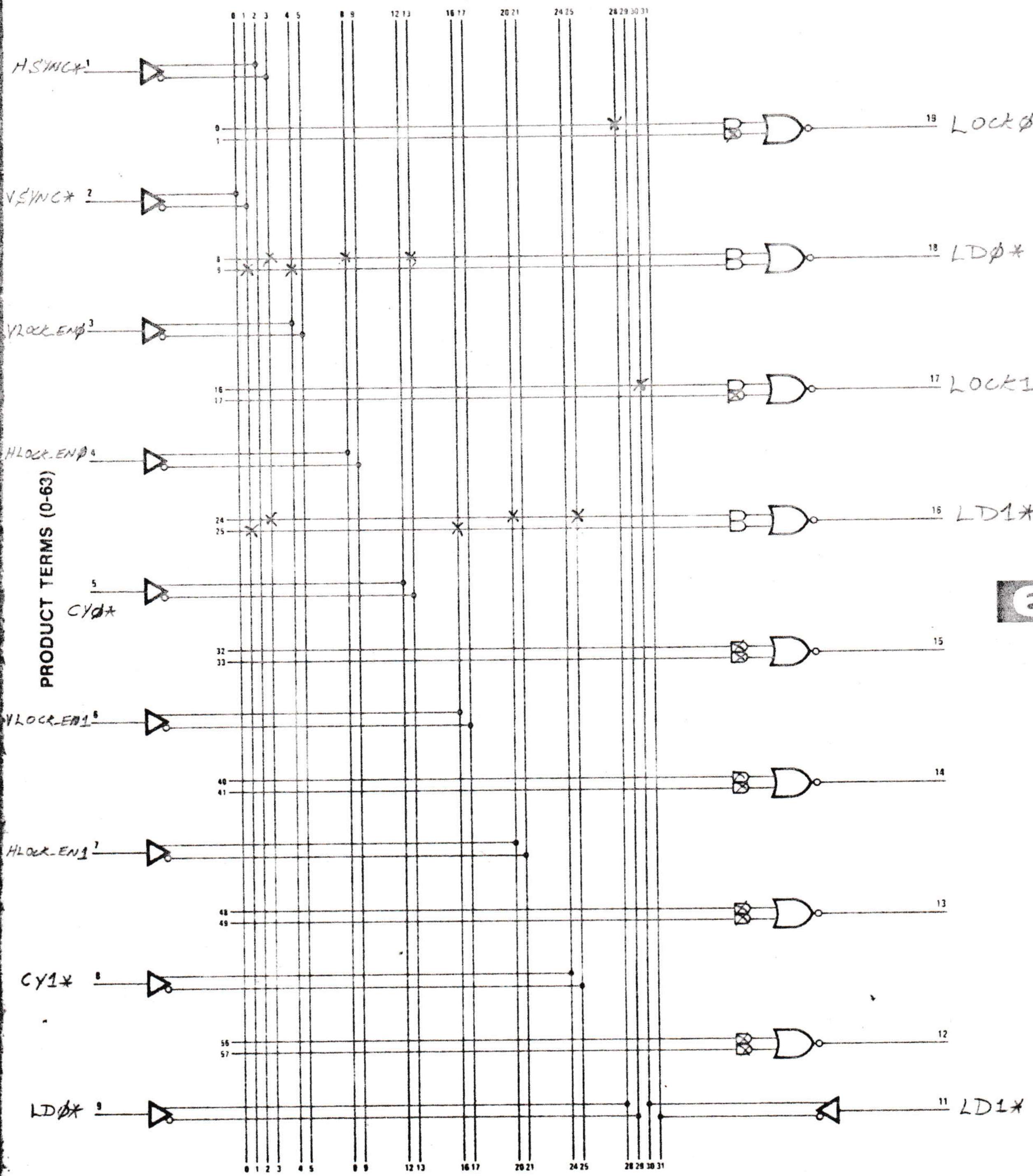
.\ccc\.VAO10PA.D1

Analog Function Decoding 3/16/93

:1004..VAO10ØADZ

VAO

Logic Diagram PAL10L8



Programming Format

PAL10L8

DATE: 3/16/83

PATTERN: Analog Function Decoding

NAME: Bob Ritchey

PRODUCT TERMS (0-63)

INPUTS (0-31)

VAO

VAO/PPA.D?

FROM: JIM RYAN DATE: 1/3/83

SUBJECT: DIGITAL OSCILLATOR WAVEFORMS PAGE: 1

The SINE/COSINE and TRIANGLE/CO-TRIANGLE digital waveform pairs have been generated and stored on disk. Each waveform pair is split into three 4K byte files, which conforms to VAO board format requirements.

FILENAME	WAVEFORM	WAVEFORM DATA BITS	FILE DATA BITS
:2..DWSINCOS.D0	SINE	7-0	7-0
:2..DWSINCOS.D1	COSINE	7-0	7-0
:2..DWSINCOS.D2	COSINE	11-8	3-0
	SINE	11-8	7-4
:2..DWTRICTR.D0	TRIANGLE	7-0	7-0
:2..DWTRICTR.D1	CO-TRIANGLE	7-0	7-0
:2..DWTRICTR.D2	CO-TRIANGLE	11-8	3-0
	TRIANGLE	11-8	7-4

```
{ This file contains the programing for the Analog Oscillator Function
  decoding PAL (U14) for the Animation Oscillator Board (VA0100A) }

0F0F 0F06 0F0F 0F0F 0D0F 0F0F 0F0D 0F0F 0F0F 0F0F 070F 0F0F 0F07 0F0F 0E0F 0B0F
0A00 0A0A 080A 0F0F 0A0A 0F0F 0A0A 0F0F 020A 0F0F 0A0A 0F0F 0A0A 0F0F 0A0A 0A0A
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F
0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
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0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
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0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

```
{ This file contains the programing for the Digital Oscillator Function
  decoding PAL (U64) for the Animation Oscillator Board (VA0100A) }

070F 0F0C 0B0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F03 0F0F 030F 0F0F 070F 0F0F 0F0C 0E0D
0C0C 0C08 0C0C 0F0F 080C 0F0F 0C0C 0F0F 0804 0F0F 0804 0F0F 0804 0F0F 080C 080C
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0E0E 0E02 0E0E 0F0F 0E0E 0F0F 0E0E 0F0F 020C 0F0F 020E 0F0F 020E 0F0F 020E 060A
0000 0000 0000 0F0F 0000 0F0F 0000 0F0F 0000 0F0F 0000 0F0F 0000 0F0F 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
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0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

```
{ This file contains the programming for the address decoding PROM (U77)
  for the Animation Oscillator board (VA0100A)  }

FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
FE FE FE FE 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
BF BF BF BF BF BF 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
FE FE FE FE 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
BF BF BF BF BF BF 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
FE FE FE FE FD FD FD FD EF EF EF EF F7 F7 F7 F7
BF BF BF BF BF BF 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
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XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
```

```
{ This file contains the programing for the Address Modifier decoding PROM
  (U98) for the Animation Oscillator Board (VA0100A) }

FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FEFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FDFF FFFF FDFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
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XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
```

```
{ This file contains the programing for the Analog Oscillator Function
  decoding PAL (U14) for the Animation Oscillator Board (VA0100A) }

0F0F 0F06 0F0F 0F0F 0D0F 0F0F 0F0D 0F0F 0F0F 0F0F 070F 0F0F 0F07 0F0F 0E0F 0B0F
0A00 0A0A 080A 0F0F 0A0A 0F0F 0A0A 0F0F 020A 0F0F 0A0A 0F0F 0A0A 0F0F 0A0A 0A0A
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
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0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F
0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
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0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

```
{ This file contains the programing for the Digital Oscillator Function
  decoding PAL (U64) for the Animation Oscillator Board (VA0100A) }

070F 0F0C 0B0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F03 0F0F 030F 0F0F 070F 0F0F 0F0C 0E0D
0C0C 0C08 0C0C 0F0F 080C 0F0F 0C0C 0F0F 0804 0F0F 0804 0F0F 0804 0F0F 080C 080C
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0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0E0E 0E02 0E0E 0F0F 0E0E 0F0F 0E0E 0F0F 020C 0F0F 020E 0F0F 020E 0F0F 020E 060A
0000 0000 0000 0F0F 0000 0F0F 0000 0F0F 0000 0F0F 0000 0F0F 0000 0F0F 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
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0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

```
{ This file contains the programming for the address decoding PROM (U77)
  for the Animation Oscillator board (VA0100A)  }

FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
FE FE FE FE 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
BF BF BF BF BF BF 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
FE FE FE FE 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
BF BF BF BF BF BF 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
FE FE FE FE FD FD FD FD EF EF EF EF F7 F7 F7 F7
BF BF BF BF BF BF 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
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XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
```

```
{ This file contains the programing for the Address Modifier decoding PROM
  (U98) for the Animation Oscillator Board (VA0100A) }

FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FEFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FDFF FFFF FDFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
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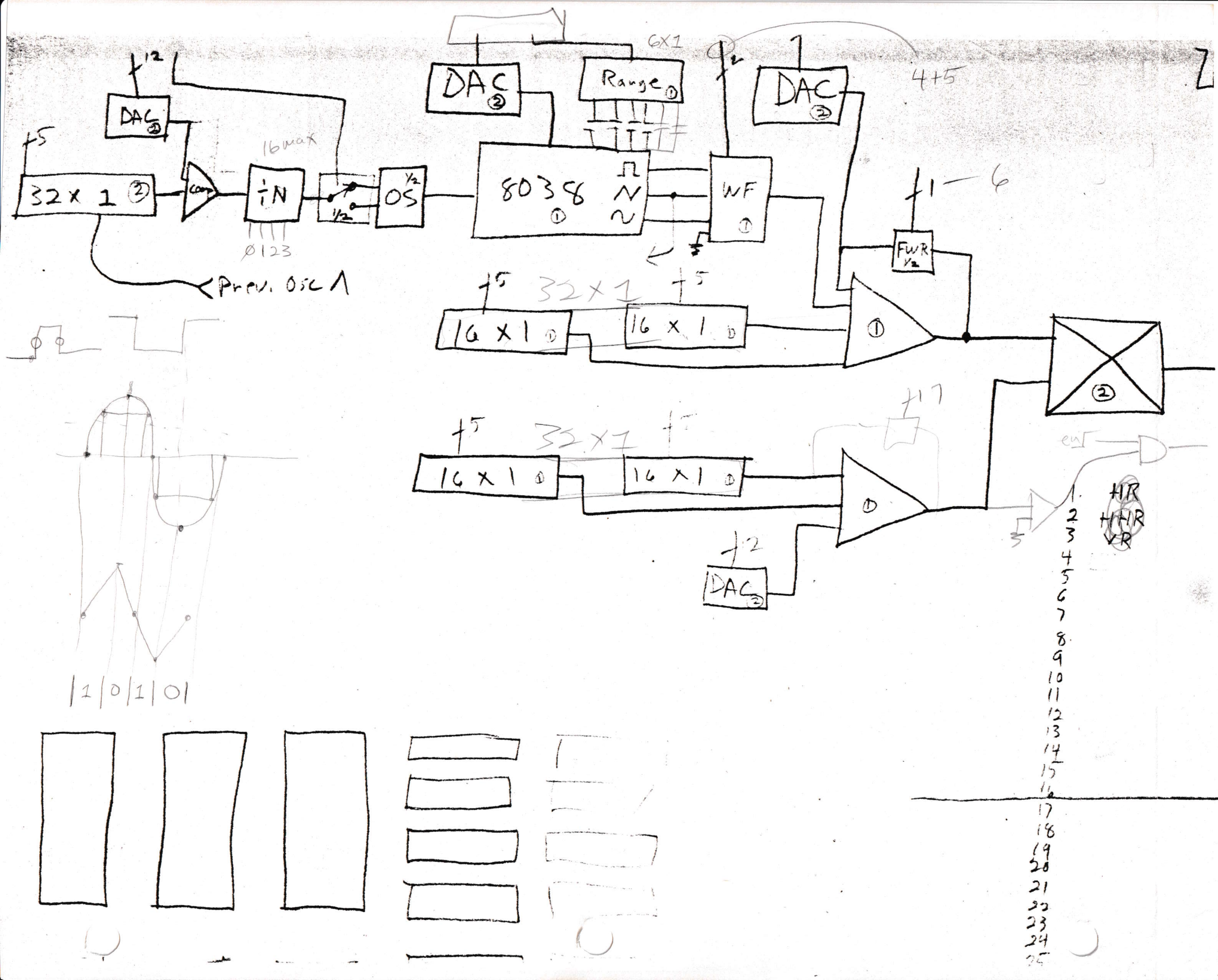
XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
```



2
DAC ②
32 x 1 ②
comp
16 max
÷N
Ø123
1/2
OS
DAC ②
8038 ①
Range ①
6X1
DAC ②
4+5
WF ①
FWR 1/2
1 — 6
Prev. OSC 1
32 x 1
16 x 1 ①
16 x 1 ①
①
②
32 x 1
16 x 1 ①
16 x 1 ①
①
DAC ②
HR
HHR
VR
1|0|1|0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
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(ORIGINAL) (4)

INTERSIL

ICL8038 Precision Waveform Generator/Voltage Controlled Oscillator

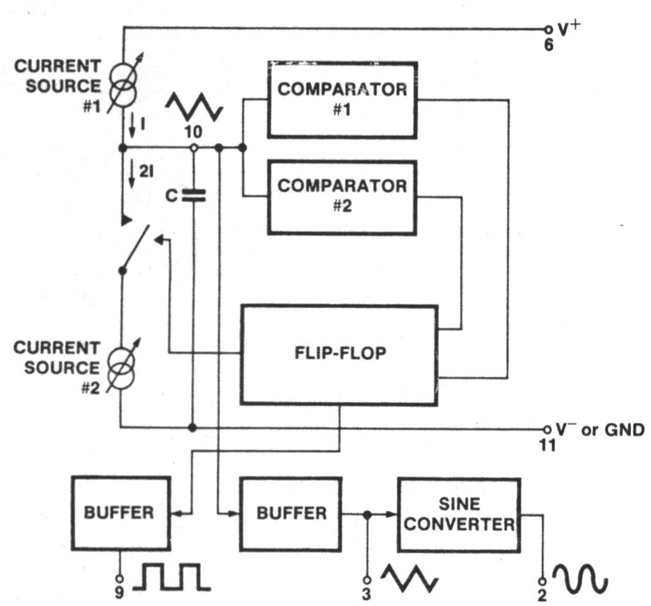
FEATURES

- **Low frequency drift with temperature - 50ppm/°C**
- **Simultaneous sine, square, and triangle wave outputs**
- **Low distortion - 1% (sine wave output)**
- **High linearity - 0.1% (triangle wave output)**
- **Wide operating frequency range - 0.001Hz to 0.3MHz**
- **Variable duty cycle - 2% to 98%**
- **High level outputs - TTL to 28V**
- **Easy to use - just a handful of external components required**

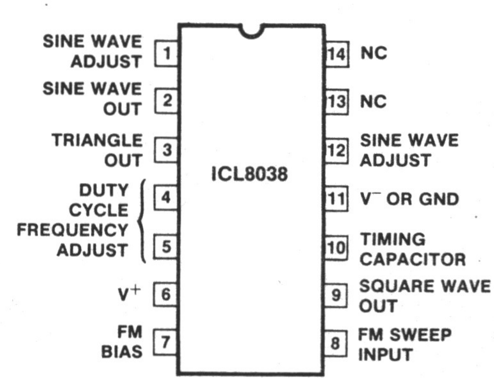
GENERAL DESCRIPTION

The ICL8038 Waveform Generator is a monolithic integrated circuit capable of producing high accuracy sine, square, triangular, sawtooth and pulse waveforms with a minimum of external components. The frequency (or repetition rate) can be selected externally from .001Hz to more than 300kHz using either resistors or capacitors, and frequency modulation and sweeping can be accomplished with an external voltage. The ICL8038 is fabricated with advanced monolithic technology, using Schottky-barrier diodes and thin film resistors, and the output is stable over a wide range of temperature and supply variations. These devices may be interfaced with phase locked loop circuitry to reduce temperature drift to less than 50ppm/°C.

BLOCK DIAGRAM



CONNECTION DIAGRAM



ORDERING INFORMATION

TYPE	TEMPERATURE RANGE	STABILITY	PACKAGE	ORDER PART NUMBER
8038 CC	0°C to +70°C	50ppm/°C typ	CERDIP	ICL8038 CC JD
8038 BC	0°C to +70°C	100 ppm/°C max	CERDIP	ICL8038 BC JD
8038 AC	0°C to +70°C	50ppm/°C max	CERDIP	ICL8038 AC JD
8038 BM	−55°C to +125°C	100ppm/°C max	CERDIP	ICL8038 BM JD
8038 AM	−55°C to +125°C	50ppm/°C max	CERDIP	ICL8038 AM JD

INTERSIL, INC., 10710 N. TANTAU AVE., CUPERTINO, CA 95014 (408) 996-5000 TWX: 910-338-0171

MAXIMUM RATINGS

Supply Voltage .... ±18V or 36V Total
Power Dissipation[1] 750mW
Input Voltage (any pin) .... Not To Exceed Supply Voltages
Input Current (Pins 4 and 5) 25mA
Output Sink Current (Pins 3 and 9) 25mA
Storage Temperature Range .... −65°C to +125°C
Operating Temperature Range:
8038AM, 8038BM .... −55°C to +125°C
8038AC, 8038BC, 8038CC .... 0°C to +70°C
Lead Temperature (Soldering, 10 sec.) .... 300°C

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

NOTE 1: Derate ceramic package at 12.5mW/°C for ambient temperatures above 100°C.

ELECTRICAL CHARACTERISTICS

(V_{SUPP} = ±10V or +20V, T_A = 25°C, R_L = 10kΩ, Test Circuit Unless Otherwise Specified)

		8038CC			8038BC/BM			8038AC/AM			
SYMBOL	**GENERAL CHARACTERISTICS**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**MIN**	**TYP**	**MAX**	**UNITS**
V_{SUPP}	Supply Voltage Operating Range										
V^+	Single Supply	+10		+30	+10		30	+10		30	V
V^+, V^-	Dual Supplies	±5		±15	±5		±15	±5		±15	V
I_{SUPP}	Supply Current (V_{SUPP} = ±10V)(2)										
	8038AM, 8038BM					12	15		12	15	mA
	8038AC, 8038BC, 8038CC		12	20		12	20		12	20	mA
FREQUENCY CHARACTERISTICS (all waveforms)											
f_{max}	Maximum Frequency of Oscillation	100,000			100,000			100,000			Hz
f_{sweep}	Sweep Frequency of FM		10			10			10		kHz
	Sweep FM Range(3)		40:1			40:1			40:1		
	FM Linearity 10:1 Ratio		0.5			0.2			0.2		%
$\Delta f/\Delta T$	Frequency Drift With Temperature(5)		50			50	100		20	50	ppm/°C
$\Delta f/\Delta V$	Frequency Drift With Supply Voltage (Over Supply Voltage Range)		0.05			0.05			0.05		%/V_{SUPP}
	Recommended Programming Resistors (R_A and R_B)	1000		1M	1000		1M	1000		1M	Ω
OUTPUT CHARACTERISTICS											
	Square-Wave										
I_{OLK}	Leakage Current (V_9 = 30V)			1			1			1	μA
V_{SAT}	Saturation Voltage (I_{SINK} = 2mA)		0.2	0.5		0.2	0.4		0.2	0.4	V
t_r	Rise Time (R_L = 4.7kΩ)		100			100			100		ns
t_f	Fall Time (R_L = 4.7kΩ)		40			40			40		ns
	Duty Cycle Adjust	2		98	2		98	2		98	%
	Triangle/Sawtooth/Ramp										
	Amplitude (R_{TRI} = 100kΩ)	0.30	0.33		0.30	0.33		0.30	0.33		xV_{SUPP}
	Linearity		0.1			0.05			0.05		%
Z_{OUT}	Output Impedance (I_{OUT} = 5mA)		200			200			200		Ω
	Sine-Wave										
	Amplitude (R_{SINE} = 100kΩ)	0.2	0.22		0.2	0.22		0.2	0.22		xV_{SUPP}
	THD (R_S = 1MΩ)(4)		0.8	5		0.7	3		0.7	1.5	%
	THD Adjusted (Use Fig. 8b)		0.5			0.5			0.5		%

NOTE 2: R_A and R_B currents not included.
NOTE 3: V_{SUPP} = 20V; R_A and R_B = 10kΩ, f ≅ 9kHz; Can be extended to 1000.1. See Figures 13 and 14.
NOTE 4: 82kΩ connected between pins 11 and 12, Triangle Duty Cycle set at 50%. (Use R_A and R_B.)
NOTE 5: Over operating temperature range, Fig. 2, pins 7 and 8 connected, V_{SUPP} = ±10V. See Fig. 6c for T.C. vs V_{SUPP}.

TEST CONDITIONS

PARAMETER	RA	RB	RL	C1	SW1	MEASURE
Supply Current	10kΩ	10kΩ	10kΩ	3.3nF	Closed	Current into Pin 6
Maximum Frequency of Oscillation	1kΩ	1kΩ	4.7kΩ	100pf	Closed	Frequency at Pin 9
Sweep FM Range (1)	10kΩ	10kΩ	10kΩ	3.3nF	Open	Frequency at Pin 9
Frequency Drift with Temperature	10kΩ	10kΩ	10kΩ	3.3nF	Closed	Frequency at Pin 9
Frequency Drift with Supply Voltage (2)	10kΩ	10kΩ	10kΩ	3.3nF	Closed	Frequency at Pin 9
Output Amplitude: Sine	10kΩ	10kΩ	10kΩ	3.3nF	Closed	Pk-Pk output at Pin 2
Triangle	10kΩ	10kΩ	10kΩ	3.3nF	Closed	Pk-Pk output at Pin 3
Leakage Current (off) (3)	10kΩ	10kΩ		3.3nF	Closed	Current into Pin 9
Saturation Voltage (on) (3)	10kΩ	10kΩ	10kΩ	3.3nF	Closed	Output (low) at Pin 9
Rise and Fall Times	10kΩ	10kΩ	4.7kΩ	3.3nF	Closed	Waveform at Pin 9
Duty Cycle Adjust: MAX	50kΩ	~1.6kΩ	10kΩ	3.3nF	Closed	Waveform at Pin 9
MIN	~25kΩ	50kΩ	10kΩ	3.3nF	Closed	Waveform at Pin 9
Triangle Waveform Linearity	10kΩ	10kΩ	10kΩ	3.3nF	Closed	Waveform at Pin 3
Total Harmonic Distortion	10kΩ	10kΩ	10kΩ	3.3nF	Closed	Waveform at Pin 2

NOTE 1: The hi and lo frequencies can be obtained by connecting pin 8 to pin 7 (f_{hi}) and then connecting pin 8 to pin 6 (f_{lo}). Otherwise apply Sweep Voltage at pin 8 ($2/3\ V_{SUPP} + 2V) \le V_{SWEEP} \le V_{SUPP}$ where V_{SUPP} is the total supply voltage. In Fig. 2, pin 8 should vary between 5.3V and 10V with respect to ground.

NOTE 2: $10V \le V^+ \le 30V$, or $\pm 5V \le V_{SUPP} \le \pm 15V$.

NOTE 3: Oscillation can be halted by forcing pin 10 to +5 volts or −5 volts.

DEFINITION OF TERMS:

Supply Voltage (V_{SUPP}). The total supply voltage from V^+ to V^-.

Supply Current. The supply current required from the power supply to operate the device, excluding load currents and the currents through R_A and R_B.

Frequency Range. The frequency range at the square wave output through which circuit operation is guaranteed.

Sweep FM Range. The ratio of maximum frequency to minimum frequency which can be obtained by applying a sweep voltage to pin 8. For correct operation, the sweep voltage should be within the range

$$(2/3\ V_{SUPP} + 2V) < V_{SWEEP} < V_{SUPP}$$

FM Linearity. The percentage deviation from the best-fit straight line on the control voltage versus output frequency curve.

Output Amplitude. The peak-to-peak signal amplitude appearing at the outputs.

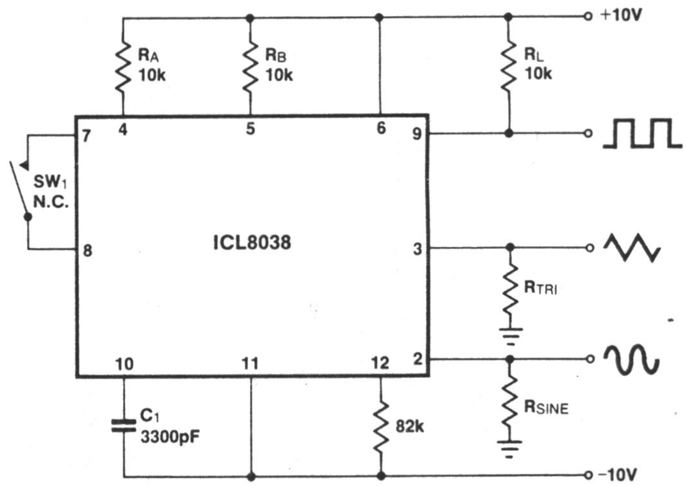
Saturation Voltage. The output voltage at the collector of Q_{23} when this transistor is turned on. It is measured for a sink current of 2mA.

Rise and Fall Times. The time required for the square wave output to change from 10% to 90%, or 90% to 10%, of its final value.

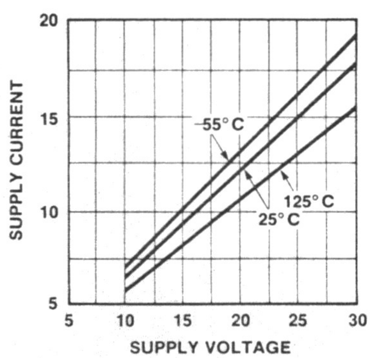
Triangle Waveform Linearity. The percentage deviation from the best-fit straight line on the rising and falling triangle waveform.

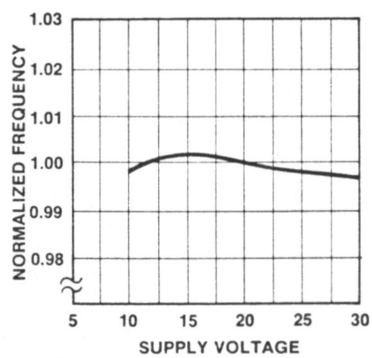
Total Harmonic Distortion. The total harmonic distortion at the sine-wave output.

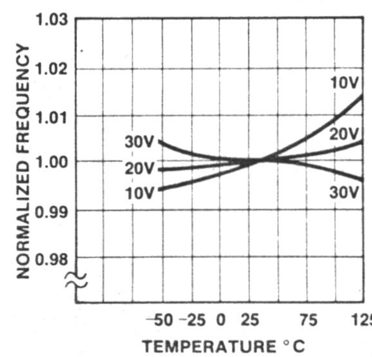
TEST CIRCUIT



TYPICAL PERFORMANCE CHARACTERISTICS







THEORY OF OPERATION (see block diagram, first page)

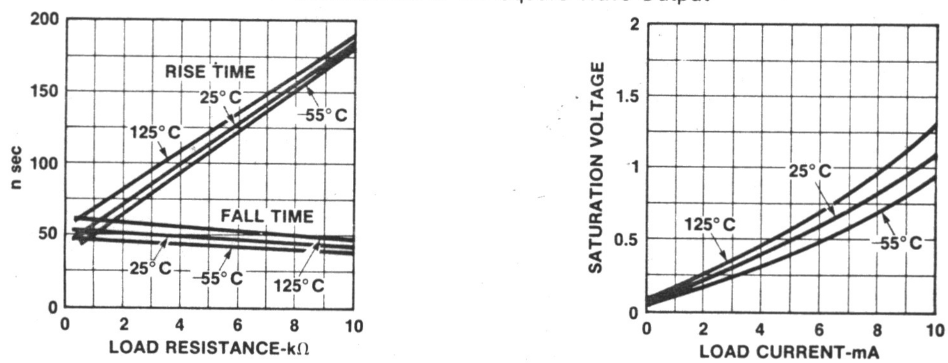
An external capacitor C is charged and discharged by two current sources. Current source #2 is switched on and off by a flip-flop, while current source #1 is on continuously. Assuming that the flip-flop is in a state such that current source #2 is off, and the capacitor is charged with a current I, the voltage across the capacitor rises linearily with time. When this voltage reaches the level of comparator #1 (set at 2/3 of the supply voltage), the flip-flop is triggered, changes states, and releases current source #2. This current source normally carries a current 2I, thus the capacitor is discharged with a net-current I and the voltage across it drops linearly with time. When it has reached the level of comparator #2 (set at 1/3 of the supply voltage), the flip-flop is triggered into its original state and the cycle starts again.

Four waveforms are readily obtainable from this basic generator circuit. With the current sources set at I and 2I respectively, the charge and discharge times are equal. Thus a triangle waveform is created across the capacitor and the flip-flop produces a square-wave. Both waveforms are fed to buffer stages and are available at pins 3 and 9.

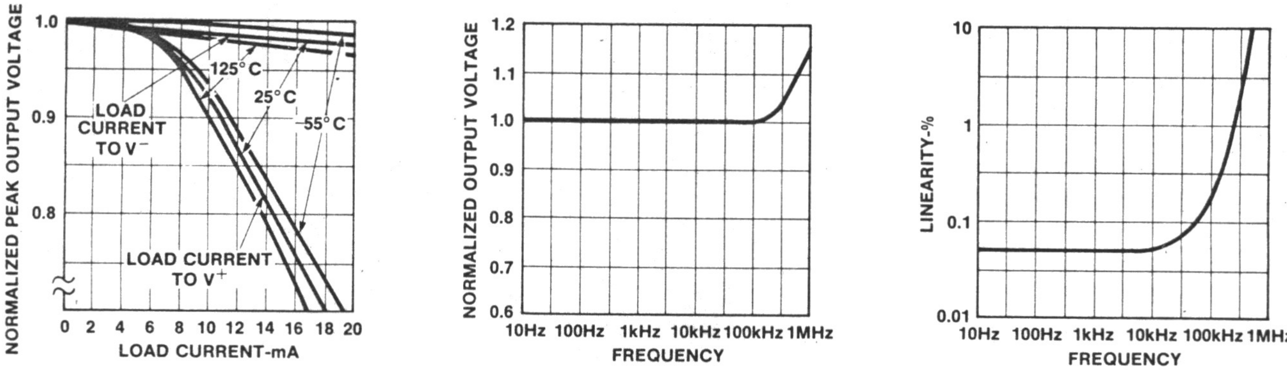
The levels of the current sources can, however, be selected over a wide range with two external resistors. Therefore, with the two currents set at values different from I and 2I, an asymmetrical sawtooth appears at terminal 3 and pulses with a duty cycle from less than 1% to greater than 99% are available at terminal 9.

The sine-wave is created by feeding the triangle-wave into a non-linear network (sine-converter). This network provides a decreasing shunt-impedance as the potential of the triangle moves toward the two extremes.

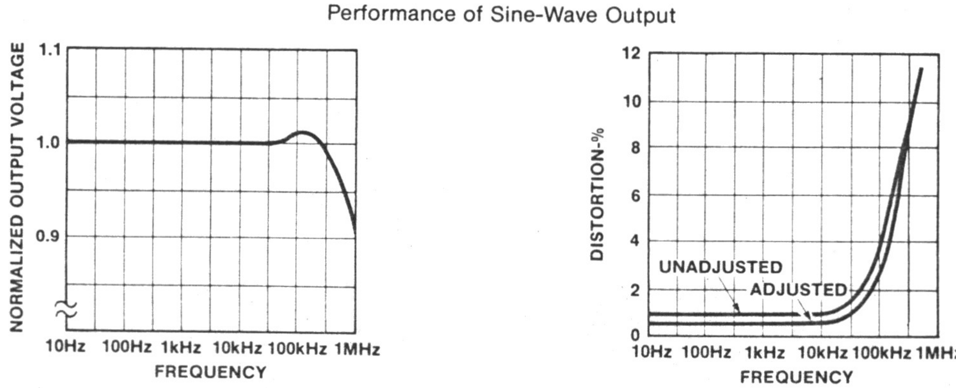
Performance of the Square-Wave Output



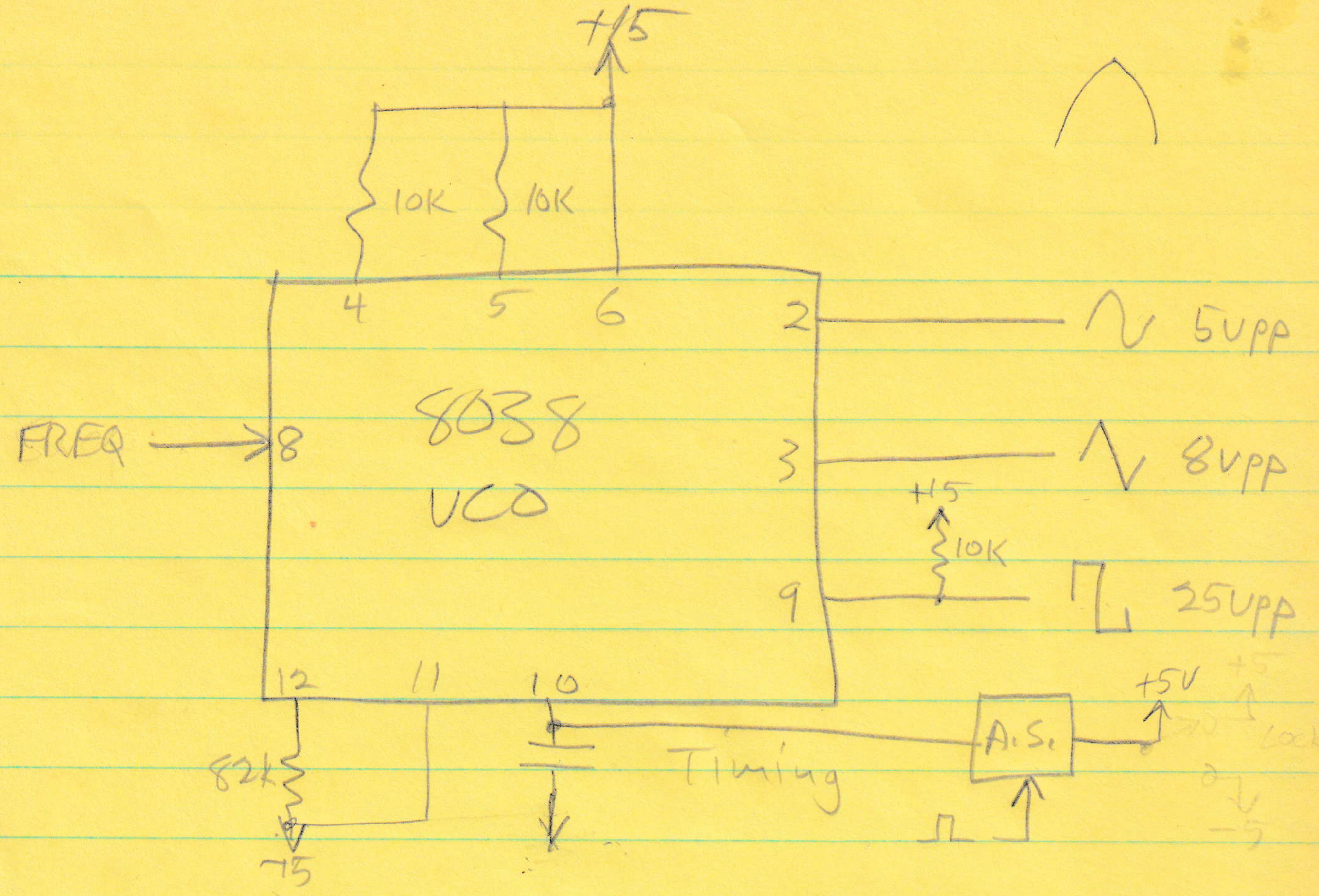
Performance of Triangle-Wave Output



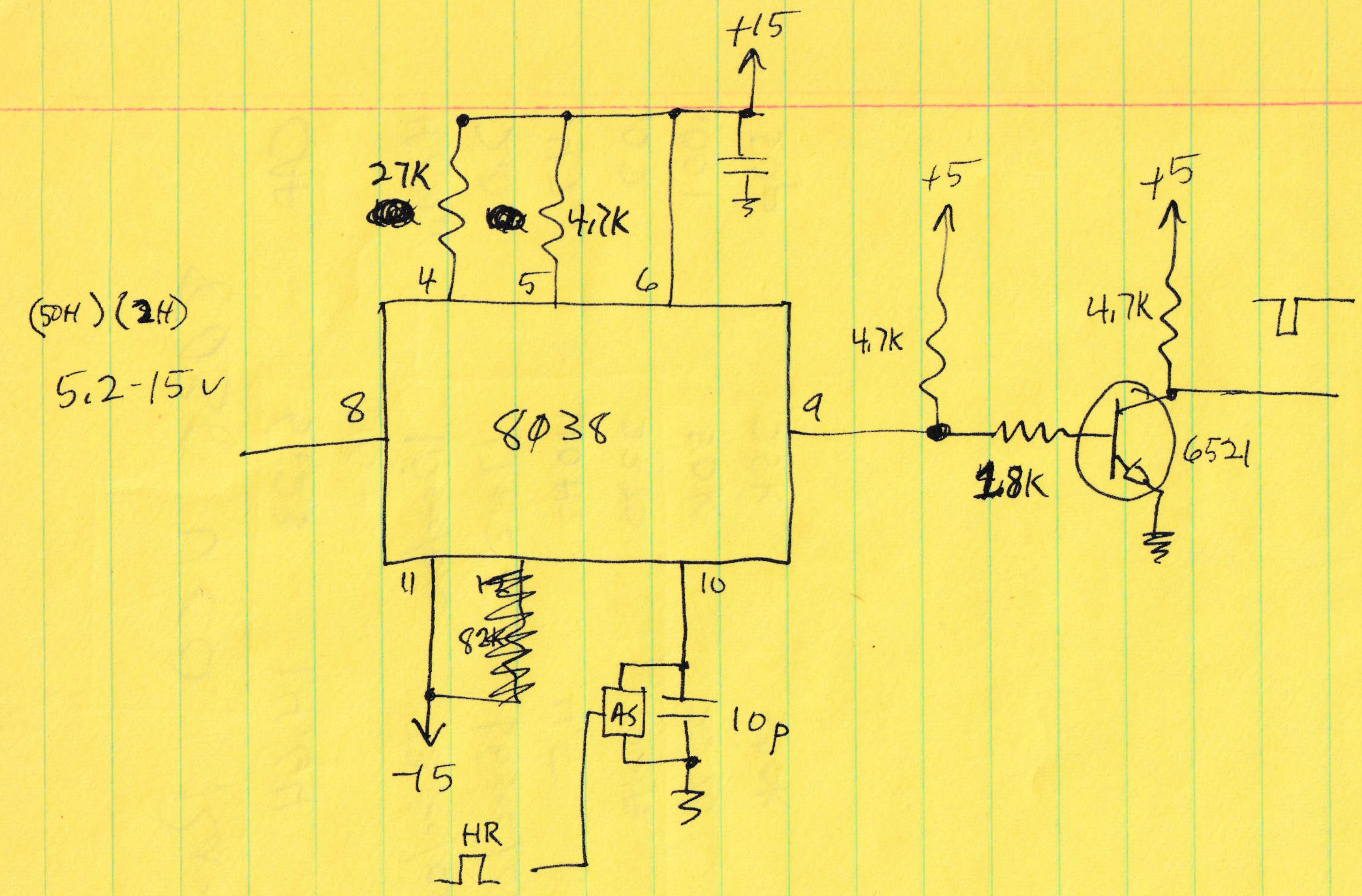
Performance of Sine-Wave Output



MIN FREQ
+15V
MAX FREQ
+5,3V

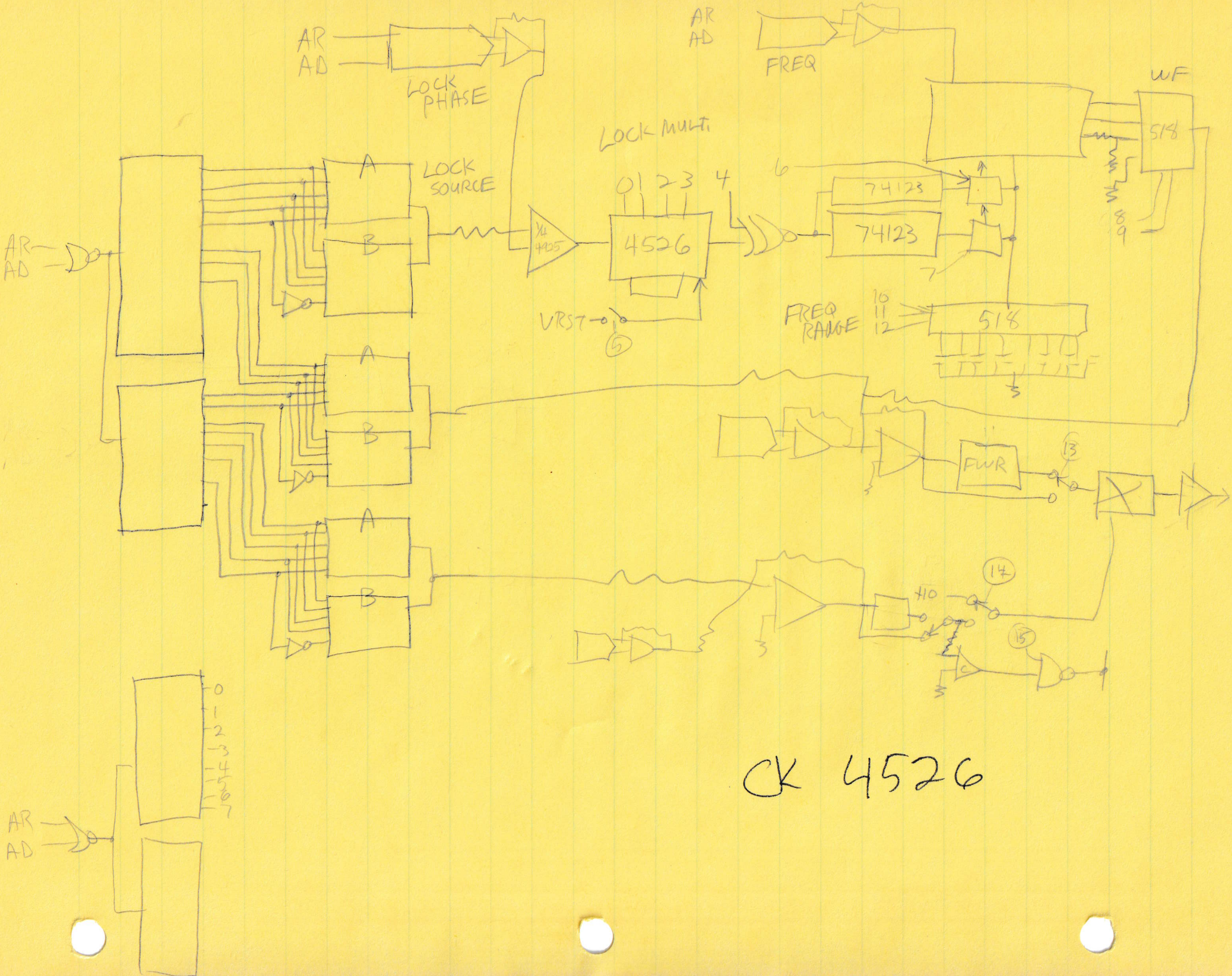


Cap	6V	8V	10V	12V	14V
.01	4,3KHz	3,5k	2,5K	1,5K	500
.05	1K	770	550	340	120
.1	500	375	270	160	55
1µ	32	25	1.8	10	3.7
[illegible]	513	14.5			
120p	295K	20K			
.0022	22K	1350			
.04	1450	85			
.52	85	5,5			

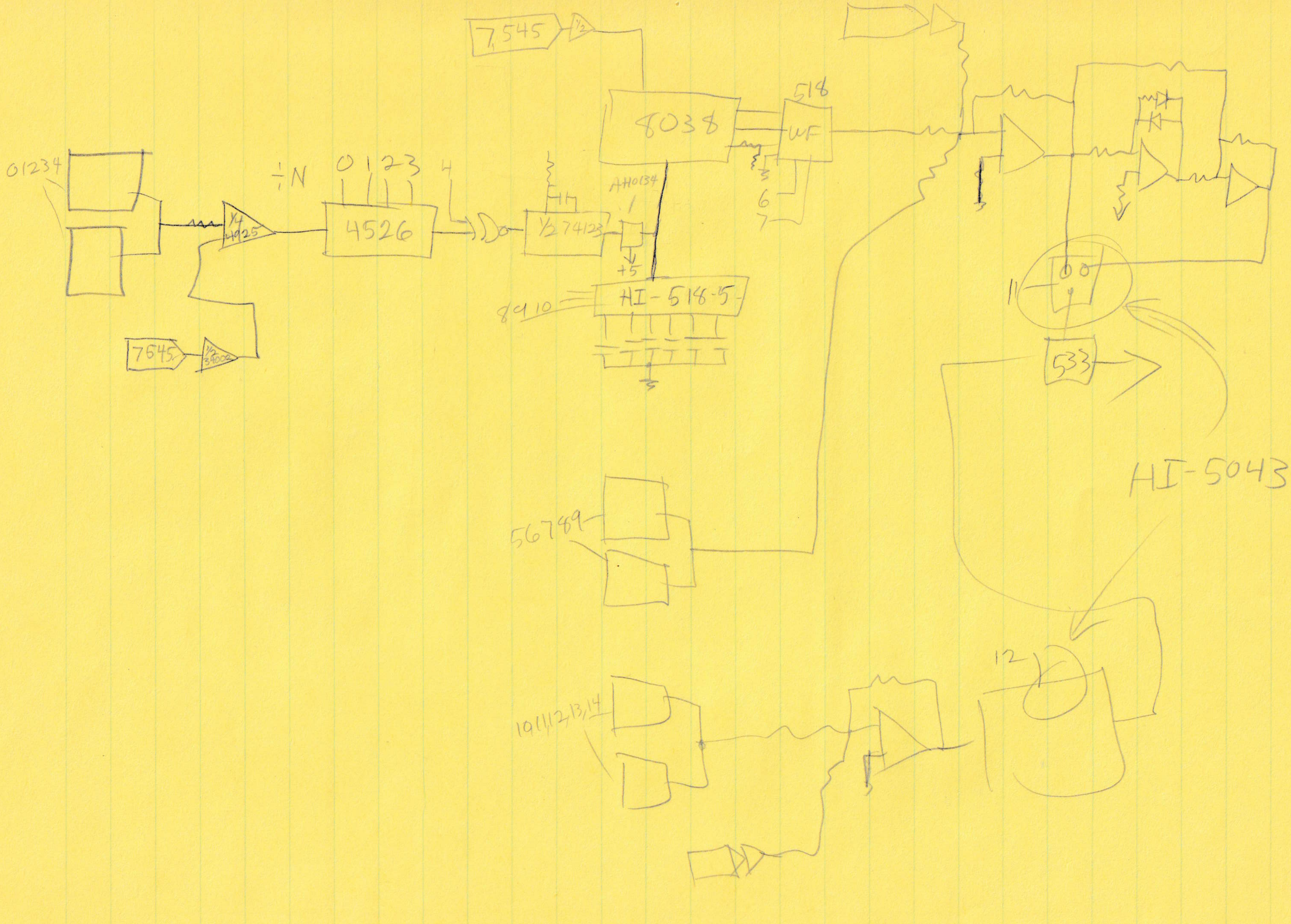

+15
27K
4.7K
4
5
6
(50H) (2H)
5.2-15v
8
8Ø38
9
+5
4.7K
1.8K
+5
4.7K
6521
11
82K
10
AS
10p
-15
HR

8038 VCO Ranges

CAP	5.23	14.64
47.0µ	1.2sec/cyc	33 sec/cyc
2.0µ	17 HZ	1.5 sec/cyc
.47µ	110 HZ	4.5
.02	2270	100 HZ
.001	50K	5570
50p	25K	500K

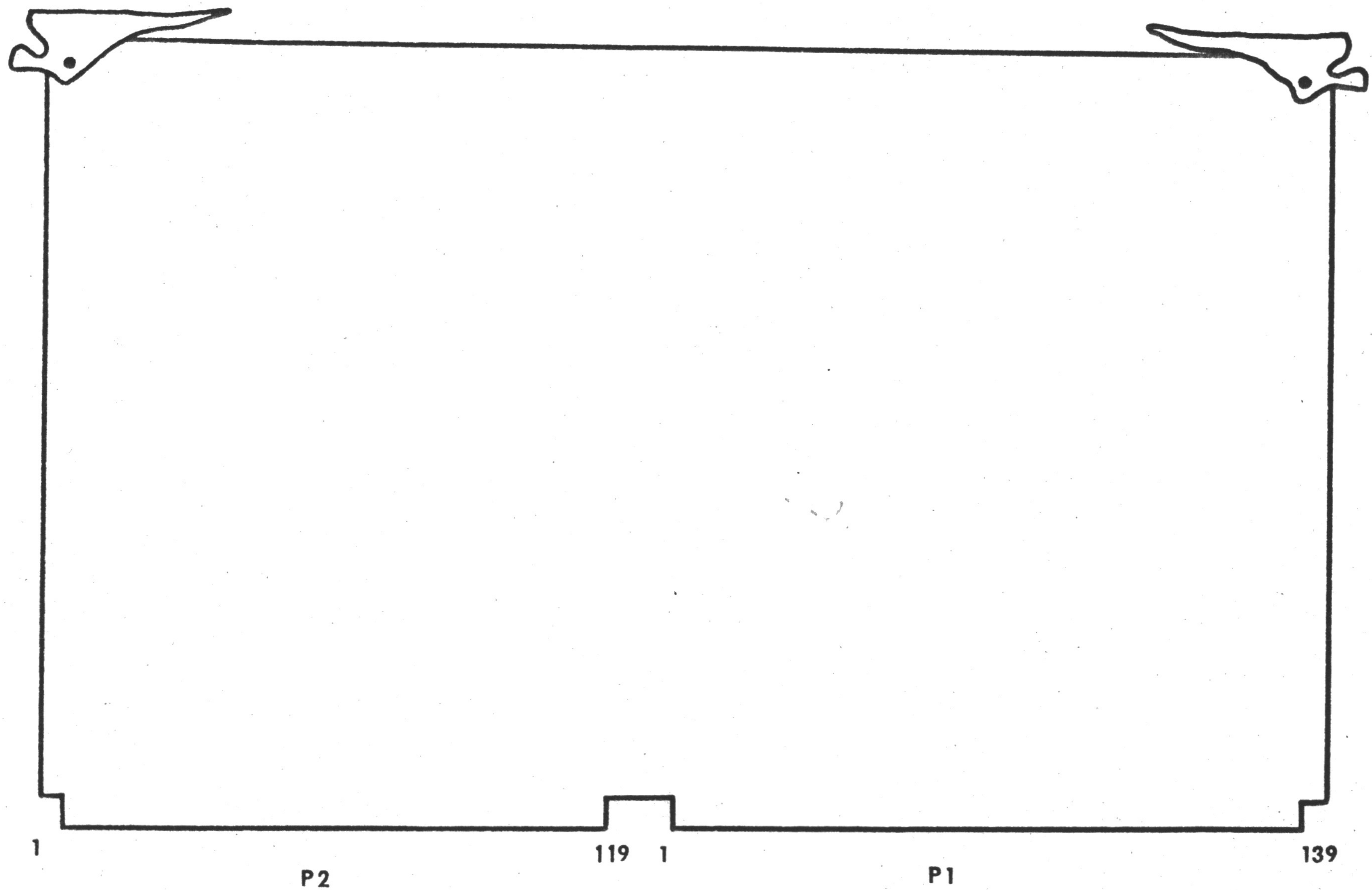

AR
AD
LOCK PHASE
FREQ
WF
LOCK MULTi
LOCK SOURCE
A
B
0 1 2 3 4
6
74123
74123
518
1/4 4925
4526
8
9
7
VRST
5
FREQ RANGE
10
11
12
518
F
FWR
13
14
+10
15
0
1
2
3
4
5
6
7

CK 4526



7,545
1/2
8038
518
WF
3
6
7
01234
÷N
0123
4
1/4
4925
4526
1/2 74123
AH0134
+5
HI-518-5
8910
7545
1/2
11
533
HI-5043
56789
1011121314
12

BOARD ____________________ VER. ____________________



VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17	DIO5	18	DIO1
19	DIO6	20	DIO2
21	DIO7	22	DIO3
23	DIO8	24	DIO4
25		26	EOI
27	GND	28	DAV
29	GND	30	NRFD
31	GND	32	NDAC
33	GND	34	IFC
35	GND	36	SRQ
37	GND	38	ATN
39	GND	40	GND
41		42	
43		44	
45		46	
47		48	
49		50	
51		52	
53		54	
55		56	
57		58	
59		60	
61		62	
63		64	
65		66	
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane. ALL other pins are.

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

This file contains the fixes for VC1100A. All changes in this file should be made on version 'A' of the board.

1) Problem: The signals VB_DS0 and VB_DS1 need to be reversed everywhere except at UG5-7.

   Fix: Cut wire from UG5-7 on solder side.
   Cut wire from UA7-5 on solder side.
   Solder jumper from UA7-5 to UC4-13.
   Solder jumper from UA7-7 to UC4-11.

2) Problem: The signals DMA_A00 and DMA_A00* need to be reversed.

   Fix: Cut wire on LEFT side of UB15-11 on solder side.
   Cut wire from UB15-10 on solder side.
   Solder jumper from UB15-11 to UC15-11.
   Solder jumper from UB15-10 to UC15-13.

3) Problem: No pullups on the RAM decoders'address inputs.

   Fix: Solder jumper from RPG1-9 to JB6-4.
   Solder jumper from RPG1-10 to JB6-3.

4) Problem: UC22-2 and UC24-1 should be DMA_GRNTD_LB instead of DMA_GRNTD_VB.

   Fix: Cut wire on RIGHT side of UC24-1 on solder side.
   Cut wire BELOW UC22-2 on solder side.
   Solder jumper from UC29-2 to UG13-3.
   Solder jumper from UC31-1 to UC22-1.
   Solder jumper from UC31-13 to UC24-1.

5) Problem: Include DMA VERSAbus access rights as bit 3 of the DMA mode register.

   Fix: Solder jumper from UB14-14 to JB8-2.

6) Problem: Reset push-button switch holes and connections were layed out wrong.

   Fix: Wire push button switch descretely:

```
                 O           O        Mounting Holes



          (1)         (2)         (3)
           O           O           O
         (NC)        (COM)        (NO)
```

   Hole 1 should be connected to the Normally Connected switch contact
   Hole 2 should be connected to the Common switch contact.
   Hole 3 should be connected to the Normally Open switch contact.

7) Problem: Read I/O DTACK and write I/O DTACK were reversed.

   Fix: Cut wire from UC7-5 on solder side.
   Cut wire from UA7-10 on solder side.
   Solder jumper from UC12-11 to UC7-10.
   Solder jumper from UC11-9 to UC7-5.

8) Problem: Tranceivers that interface the TMS9914A to the local data bus didn't have the output enables decoded.

Fix: Cut wire from UD4-19 on solder side.
Cut wire from UD5-19 on component side.
Solder jumper from UD7-6 to UD4-19.
Solder jumper from UD7-8 to UD5-19.
Solder jumper from UD7-4 to UD7-9.
Solder jumper from UA19-8 to UD7-9.
Solder jumper from UC15-7 to UD7-5.
Solder jumper from UC15-9 to UD7-10.
Solder jumper from UG11-10 to UA19-10.
Solder jumper from UC1-4 to UA19-9.

9) Problem: RS2 and RS0 reversed on TMS9914A chip.

Fix: Cut wire from UD1-6 on component side.
Cut wire from UD1-8 on component side.
Solder jumper from UD1-6 to UA6-16.
Solder jumper from UD1-8 to UA6-12.

10) Problem: REN and IFC tied together on TMS9914A and 75162A.

Fix: Cut wire between UD1-22 and UD1-23 on solder side.
Cut wire between UD1-23 and UD3-20 on solder side.
Cut wire between UD3-20 and UD3-19 on solder side.
Solder jumper from UD1-22 to UD3-20.
Solder jumper from UD1-23 to UD3-19.

11) Problem: Enable input on 9519A is positive logic and it was tied to ground.

Fix: Cut wire between UG7-14 and UG7-13 on solder side.

12) Problem: Interrupt acknoledge's level decoder wired incorrectly to interrupt response's jumper block.

Fix: Cut wire from UG3-15 on solder side.
Solder jumper from UG3-7 to JB4-7.

13) Problem: When Multi-Wire reversed the power and ground on the AM2940 chips, they forgot to change the wired ground connections to the pins on the chips, thus pins that should have been grounded were tied to VCC.

Fix: Cut wire from UB3-8 on solder side.
Cut wire from UB4-8 on solder side.
Cut two wires from UB4-8 on solder side.
Solder jumper from UB3-22 to UB3-20.
Solder jumper from UB4-22 to UB4-20.
Solder jumper from UB5-22 to UB5-20.
Solder jumper from UB5-20 to UB5-9.

14) Problem: Multi-wire mis-wired IO_WR* to the front panel logic.

Fix: Cut wire on BOTH sides of UF4-13 on solder side.
Solder jumper from UB16-11 to UF4-9.
Solder jumper from UC12-10 to UF4-13.

15) Problem: There is an undocumented GLITCH on the 'GINT' line of the AMD 9519A. This caused a second interrupt request to follow the end of the first request. The fix was to insure the requests are at least 200ns long.

Fix: Cut wire on BOTH sides of UG10-2 on solder side.
Cut wire from UG10-1 on solder side.
Cut wire from UG10-3 on solder side.
Cut wire from UG10-5 on solder side.

Solder Jumper from UG10-1 to UG10-13.
Solder Jumper from UG10-3 to UG10-11.
Solder Jumper from UG10-5 to UG10-12.
Solder Jumper from UG10-10 to UG10-14.
Solder Jumper from UG10-9 to UG5-3.
Solder Jumper from UG11-4 to UG10-2.
Solder Jumper from UG11-4 to UA19-13.
Solder Jumper from UG10-1 to UA19-11.
Solder Jumper from UG5-12 to UA19-12.

16) Problem: BGXOUT should be a TTL T.P. output and a 74S38 was used on the line. It needs to have a pullup.

Fix: Solder Jumper from UG2-8 to RPG1-8.

17) Problem: UC32 had pins 8 and 10 reversed.

Fix: Cut wire on BOTH sides of UC32-8 on solder side.
Cut wire from UC32-10 on solder side.
Solder Jumper from UC23-3 to UC32-8.
Solder Jumper from UC20-5 to UC32-10.
Solder Jumper from UC6-2 to UC32-10.

```
{ This file contains the programing for the VERSAbus Requester (UG4) on the
  Communications Interface Board (VCI100A). }

0303 0303 0303 0303 0303 0303 0303 0303 0303 0303 0303 0303 0303 0303 0303 0303
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0008 0808 0800 0808 0008 0808 0808 0008 0808 0808 0808 0808 0808 0808 0808 0808
0909 0108 0809 0909 0909 0909 0909 0901 0909 0909 0909 0909 0909 0909 0909 0909
060F 0F0F 0F0B 0F0F 0F0F 0F0F 0F0F 0F05 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F
0F0F 0F0F 0F0D 0F0F 0F0F 0F07 0F0F 0A07 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F
0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F0F 0F00 0F0F
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
```

{ This file contains the programming for the VERSAbus Interrupter (UG5) on the
Communications Interface Board (VCI100A). }

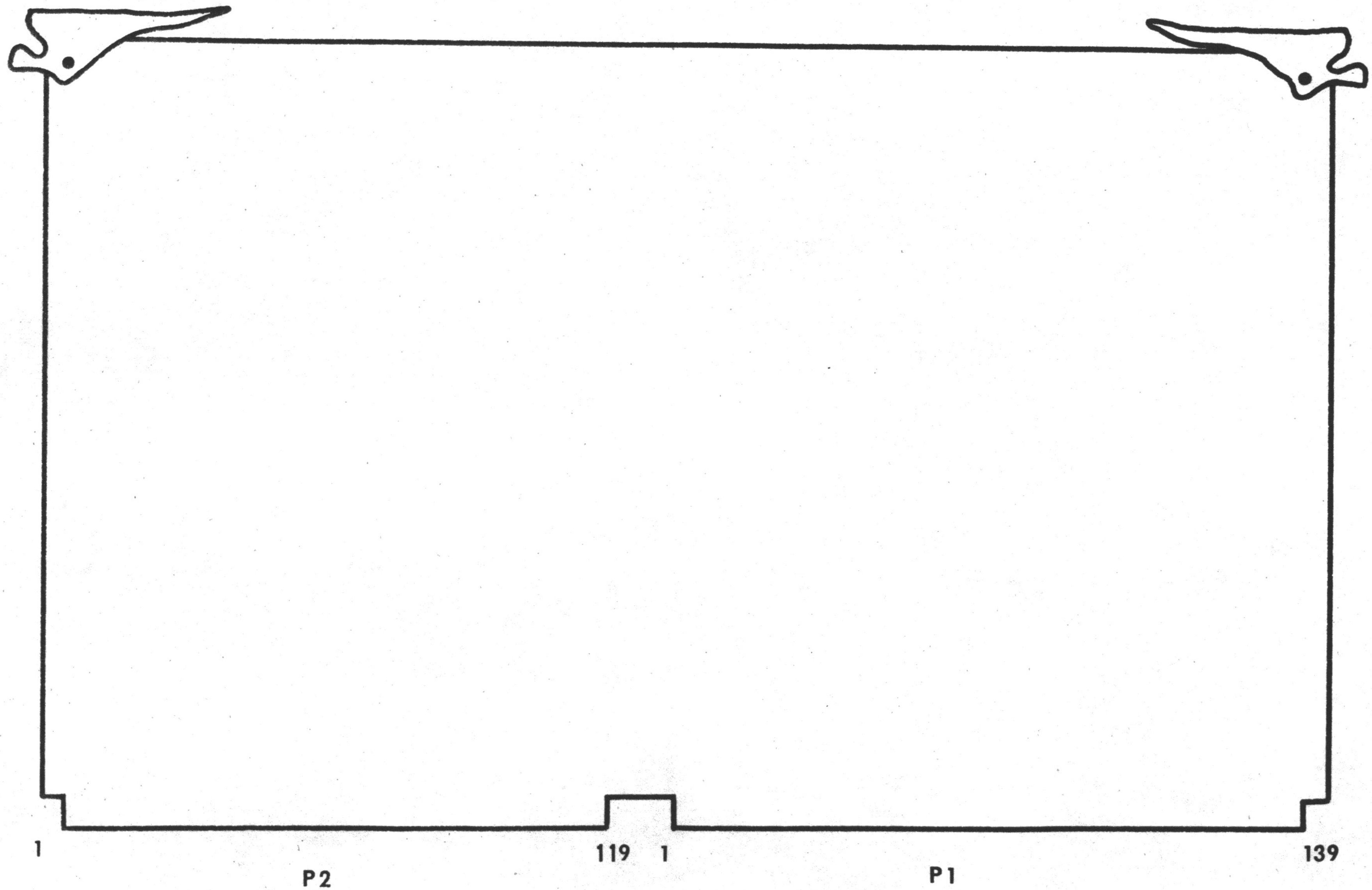
```
0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101 0101
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0101 0101 0101 0101 0100 0101 0100 0101 0101 0101 0101 0101 0101 0101 0101 0101
0405 0505 0505 0505 0505 0505 0505 0105 0505 0505 0505 0505 0505 0505 0505 0505
0D0D 0D0D 0D09 0D0D 0D0D 0D0D 0D0D 0D0D 0D0C 050D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D
0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D00 0D0D
0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C 0C0C
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D0D 0D00 0C0D 0D0D 0D0D 0D0D 080D 0D0D
0D0C 0D0D 0D0D 0D0D 0D0C 080D 0D0C 0D0D 0C0D 0D0D 0C0D 0D0D 0C0D 0D0D 0805 0D0D
```

Reference No's	Total	Part Name	Part Type	Description
C1-3	3	C 47UF 20V TAN	CAPACITOR	47 UF 20V TANTALUM CAPACITOR
C4-65	62	C .1UF 50V CER .25S	CAPACITOR	.1 UF 50V CERAMIC CAPACITOR
J1	1	J SCOTCHFLEX 40-RAST	JACK	40 PIN RIGHT ANGLE SOLDER TAIL HEADER
JB1-2,5,22	4	JB-10	JUMPER BLK	10 PIN JUMPER BLK
JB3-4	2	JB-14	JUMPER BLK	14 PIN JUMPER BLK
JB6	1	JB-4	JUMPER BLK	4 PIN JUMBER BLOCK
JB7-8	2	JB-2	JUMPER BLK	2 PIN JUMPER BLK
JB10	1	JB-18	JUMPER BLK	18 PIN JUMPER BLK
P1	1	P SCOTCHFLEX 40	PLUG	40 PIN CONNECTOR
RA1-2,RD1-2	4	R 3.3K OHM 1/4W 2%	RESISTOR	3.3K OHM 1/4W 2% RESISTOR
RC1,RG1	2	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
RPA1-3,RPB1,RPC1, RPG1	6	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
SUA1-17,SUB1-2,6-14, SUC4,15-16,SUD2,4-5, SUF1-2,SUG4-6,8-9	41	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SUA18-19,SUB15-18, SUC2-3,5-7,9-14, 17-32,SUD6-8,SUE2-3, 12,SUF4-5,SUG1-2, 10-13	47	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SUB3-5,SUG7	4	DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET
SUC1,SUE1,SUF3,SUG3	4	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SUD1	1	DIP SOCKET-40 ST	SOCKET	40 PIN SOLDER TAIL DIP SOCKET
SUD3	1	DIP SOCKET-22 ST	No description found in cross ref file	
SUE4-11	8	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SW1,3	2	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
SW2	1	SW DIP-4	SWITCH	4 POSITION DIP SWITCH
SW4	1	SW DIP-2	SWITCH	2 POSITION DIP SWITCH
SW9	1	SW PB SPDT	SWITCH	SPDT PUSH-BUTTON SWITCH

Reference No's	Total	Part Name	Part Type	Description
UA1-2, 12-17, UG6	9	25LS2521	IC	8 BIT COMPARATOR
UA3-9, UC4, 15-16, UF1-2	12	74LS240	IC	OCTAL BUS DRIVER
UA10-11, UB9-13, UG9	8	74S240	IC	OCTAL BUS DRIVER
UA18, UG12-13	3	74S02	IC	QUAD 2-INPUT NOR GATE
UA19, UB18	2	74LS08	IC	QUAD 2-INPUT AND GATE
UB1-2, 6-8	5	74LS244	IC	OCTAL BUS DRIVER
UB3-5	3	AM2940	IC	DMA ADDRESS GENERATOR
UB14	1	25LS2519	IC	QUAD REGISTER W/TWO 3-STATE OUTPUTS
UB15, UC11, 21, UE12, UF5, UG11	6	74LS04	IC	HEX INVERTER
UB16-17, UC18, 20, 28, 32, UE2	7	74LS02	IC	QUAD 2-INPUT NOR GATE
UC1, UE1	2	74S139	IC	DUAL 2-TO-4 LINE DECODER
UC2, 7, 29, UE3	4	74LS00	IC	QUAD 2-INPUT NAND GATE
UC3, UG2	2	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
UC5, 30-31	3	74LS10	IC	TRIPLE 3-INPUT NAND GATE
UC6, 17	2	74LS11	IC	TRIPLE 3-INPUT AND GATE
UC9-10, 12-13, 22-24	7	74LS164	IC	8 BIT SERIAL IN/ PARALLEL OUT REGISTER
UC14, UD7, UF4	3	74LS32	IC	QUAD 2-INPUT OR GATE
UC19	1	74S260	IC	DUAL 5-INPUT NOR GATE
UC25, UG10	2	74LS74A	IC	DUAL D FLIP-FLOP
UC26-27	2	74S74	IC	DUAL D FLIP-FLOP
UD1	1	TMS9914A	IC	IEEE-488 CONTROLLER
UD2	1	75160A	IC	IEEE-488 BUS DRIVER
UD3	1	75162A	IC	IEEE-488 BUS DRIVER
UD4-5, UG8	3	74LS245	IC	OCTAL BUS TRANCIEVER
UD6	1	5 MHZ OSC	OSCILLATOR	5 MHZ OCSILLATOR

Reference No's	Total	Part Name	Part Type	Description
UD8	1	74LS86	IC	QUAD 2-INPUT EXOR GATE
UE4-11	8	TMM2016	IC	2KX8 STATIC RAM
UF3	1	74LS175	IC	QUAD REGISTER W/CLEAR
UG1	1	74LS30	IC	8-INPUT NAND GATE
UG3	1	74S138	IC	3-TO-8 LINE DECODER
UG4-5	2	PAL16R4	IC	16R4 PAL LOGIC ARRAY
UG7	1	AM9519A-1	IC	INTERRUPT CONTROLLER

BOARD ____________________ VER. ____________________



VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
1	GND	2	GND
3	GND	4	GND
5	GND	6	GND
7	+5V	8	+5V
9	+5V	10	+5V
11	+12V	12	+12V
13	GND	14	GND
15	-12V	16	-12V
17		18	
19		20	
21		22	
23		24	
25		26	
27		28	
29		30	
31		32	
33		34	
35		36	
37		38	
39		40	
41		42	
43		44	
45		46	
47		48	
49		50	
51		52	
53		54	
55		56	
57		58	
59		60	
61		62	
63		64	
65		66	
67	-15V	68	-15V
69	+15V	70	+15V

NOTE: Pins 17 through 66 are not bussed across by the backplane.
ALL other pins <u>are</u>.

(Page 2) VERSEFX J2/P2 PIN ASSIGNMENTS (MODIFIED VERSABUS)

COMPONENT SIDE		SOLDER SIDE	
PIN #	SIGNAL NAME	PIN #	SIGNAL NAME
71		72	
73	RB*	74	
75	VI*	76	VR*
77	HR*	78	ZR*
79	HI*	80	VALE*
81	HC*	82	LHC*
83	BKG*	84	S1*
85	S2*	86	S3*
87	S4*	88	LB*
89	SB*	90	FI*
91	VAL*	92	PRHR*
93	HB	94	GHR*
95		96	
97	GND	98	GND
99		100	
101		102	
103		104	
105		106	
107		108	
109		110	
111		112	
113		114	
115		116	
117		118	
119		120	

* Denotes active LOW

RB = RASTER RELATIVE BLANKING
VI = VERTICAL INTERVAL
VR = VERTICAL RESET
HR = HORIZONTAL RESET
ZR = Z RESET
HI = HI-RESOLUTION SYNC MODE
VALE= VERTICAL AXIS LOCATE ENABLE
HC = HORIZONTAL CLAMP
LHC= LO-RESOLUTION HORIZONTAL CLAMP
BKG= BLANKING TO CRT
S1-S4 = SECTION ADDRESS LINES
LB = LO-RESOLUTION BLANKING
SB = SCREEN RELATIVE BLANKING
FI = FIELD IDENTIFICATION
VAL= VERTICAL AXIS LOCATE
PRHR= PROGRAMMABLE HI-RESOLUTION HORIZONTAL RESET
GHR= GRAPHICS HORIZONTAL RESET
HB = HORIZONTAL BLANKING

TIME CODE CABLE TO GRAY

PARALLEL TIME CODE DATA OUTPUTS (42 pin Female MRAC)

29 Bit Parallel TTL Lines (Parallel to Readout Display)

3, 4, 11, 19, 35, 36, 37, 38, 39, 40

NOT USED

	PIN		BCD TIME CODE
1	A	4	COMMON
34	B		FRAMES: 1
33	C		FRAMES: 2
32	D		FRAMES: 4
31	E		FRAMES: 8
30	F		FRAMES: 10
29	H		FRAMES: 20
28	J		DROP FRAME CODE
	K		COLOR LOCK FLAG
26	L	BLUE	SECONDS: 1
25	M	GREEN	SECONDS: 2
24	N	YELLOW	SECONDS: 4
23	P	ORNG	SECONDS: 8
22	R	RED	SECONDS: 10
21	S	BROWN	SECONDS: 20
20	T	BLK	SECONDS: 40
27	U	PURPLE	FIELD FLAG
18	V		MINUTES: 1
17	W	PURPLE	MINUTES: 2
16	X	BLUE	MINUTES: 4
15	Y	GRN	MINUTES: 8
14	Z	YELLOW	MINUTES: 10
13	AA	ORNG	MINUTES: 20
12	BB	RED	MINUTES: 40
2	CC	3 w/10	COMMON
10	DD	BLK	HOURS: 1
9	EE		HOURS: 2
8	FF		HOURS: 4
7	HH		HOURS: 8
6	JJ		HOURS: 10
5	KK		HOURS: 20
39	LL	11	COMMON
40	MM	19	COMMON

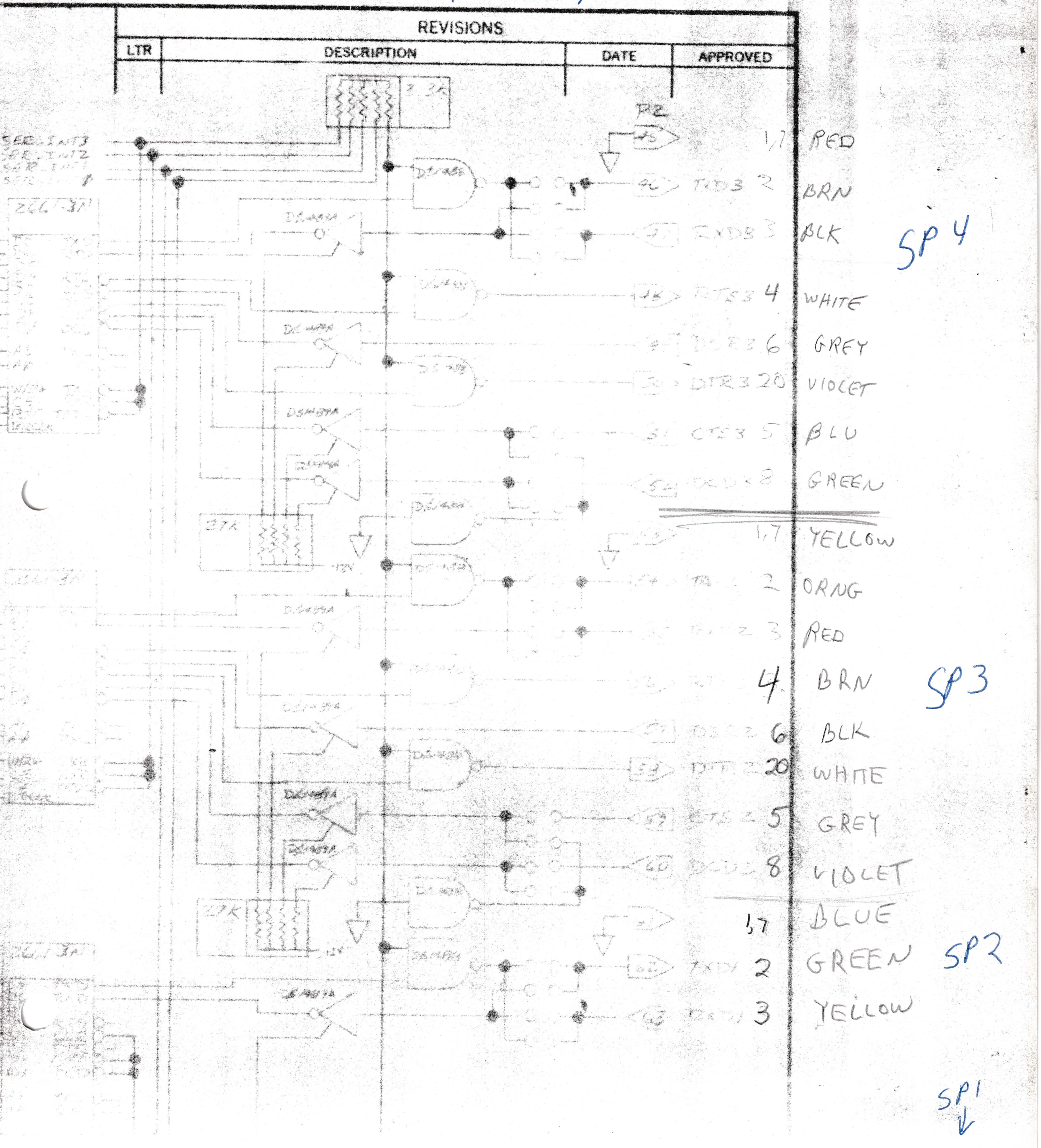
REMOTE IN/OUT CONNECTOR (26 pin Female MRAC)

18 Lines for remote switches, tallies, and a test oscillator control; 1 pulse per frame signal; 1 pulse per second signal; 20 volts DC unregulated for tally lamps. All switches are momentary to common except TEST, DIRECTION, and USER BIT SLAVE switch. All lamps have +20 volts unregulated as common connection.

PIN	DESIGNATION
A	RUN SWITCH
B	HOLD LAMP
C	RUN LAMP
D	LOAD SWITCH
E	RESET SWITCH
F	DROP FRAME SWITCH
H	NON DROP FRAME LAMP

SERIAL PORT RIBBON TO CONNECTORS. DB 26

SFP SYSTEM



50
-116
34

```
{ This file contains the programing for the Address Modifier decoding PROM
  for the Console Connect Board (VCC100A) }

FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
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FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FEFF FFFF FFFF FFFF
FFFF FFFF FFFF FFFF FFFF FDFF FFFF FDFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
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XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX
```

```
{         The programing for the decoding PAL (U34) is contained in the file
VCC100A.D1.  The PAL takes the select inputs and generates the appropriate
selects for the serial ports, the interrupt controller's WR* line, the A/D
selects and the DTACK signal for the VERSAbus.  For the PAL encoding the user
reference the equivalent logic schematic and/or the standard PAL coding forms
for the logical connections.  The data should be converted to S-records using
the program SCNVRT.   }

0F0F 0F0F 0F00 0F0F 0F0F 0F0F 0A05 0F0F 0C03 0F0F 0F00 0F0F 000F 0F0F 0F0F 0F0F
0F0F 0F0F 0F00 0F0F 0F0F 0F0F 0A05 0F0F 0C03 0F0F 0F0F 0F0F 0F00 0F0F 0F0F 0F0F
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0E0E 0E08 0E0E 0F0F 060E 0F0F 0E0E 0F0F 0C0A 0F0F 060E 0F0F 0E08 0F0F 060E 0E0E
0908 0909 0909 0F0F 0901 0F0F 0909 0F0F 0909 0F0F 0908 0F0F 0809 0F0F 0109 0901
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
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```
{ This file contains the programming for the address decoder for VCC100A }
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
9E 9E 9E 9E 9E 9E 9E 9E 9B 9B 9B 9B 9B 9B 9B 9B
97 97 97 97 97 97 97 97 97 97 97 97 97 97 97 9D
EF EF EF EF EF 7F 7F 7F DB DB DB DB DB DB DB DB
D7 D7 D7 D7 D7 D7 D7 D7 D7 D7 D7 D7 D7 D7 D7 DD
9E 9E 9E 9E 9E 9E 9E 7F 9B 9B 9B 9B 9B 9B 9B 9B
97 97 97 97 97 97 97 97 97 97 97 97 97 97 97 9D
EF EF EF EF EF 7F 7F 7F BB BB BB BB BB BB BB BB
B7 B7 B7 B7 B7 B7 B7 B7 B7 B7 B7 B7 B7 B7 B7 BD
7F 7F 7F 7F 7F 7F 7F EF 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
EF EF EF EF EF 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
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XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX
```

Stuffing List for VCC100A VCC

Reference No's	Part Name	Part Type	Description
C1	C 2.2UF 25V TAN	No description found in cross ref file	
C2	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C3	C .01UF 50V CER	CAPACITOR	.01 UF CERAMIC CAPACITOR
C4-18	C ?	No description found in cross ref file	
C19	C 100UF 20V TAN	CAPACITOR	100 UF 20V TANTALUM CAPACITOR
C20-26	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
J1-3	J SCOTCHFLEX 40-RAST	JACK	40 PIN RIGHT ANGLE SOLDER TAIL HEADER
R1	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R2	R 1 OHM 1/2W 1%	RESISTOR	1 OHM 1/2W 1% RESISTOR
R3	R 56K OHM 1/4W 2%	No description found in cross ref file	
R4	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R5	R 27.4K OHM 1/4W 2%	RESISTOR	27.4K OHM 1/4W 2% RESISTOR
R6	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R7	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R8	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R9	Reference not found in component list		
R10	Reference not found in component list		
R11	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R12	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R13	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R14	R 27K OHM 1/4W 2%	No description found in cross ref file	
R15	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R16	R 56K OHM 1/4W 2%	No description found in cross ref file	
RP1-2	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
RP3-4	RP 27K OHM SIP-10	No description found in cross ref file	
RP5-6	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
RV1	Reference not found in component list		
RV2	Reference not found in component list		
RV3	Reference not found in component list		
RV4	Reference not found in component list		
RV5	Reference not found in component list		
RV6	Reference not found in component list		
RV7	Reference not found in component list		
RV8	Reference not found in component list		
RV9-10	RV 20K BOURNS 3299	No description found in cross ref file	
S1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
S2	SW DIP-4	SWITCH	4 POSITION DIP SWITCH
SU1	RND SOCKET-8 ST	SOCKET	8 PIN SOLDER TAIL ROUND SOCKET
SU2-6	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU7-10	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU11	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET

Reference No's	Part Name	Part Type	Description
SU12-15	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU16	DIP SOCKET-8 ST	No description found in cross ref file	
SU17-18	DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET
SU19-22	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU23	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SU24-27	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU28-31	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SU32-33	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU34	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU35	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU36-39	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU40	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SU41-42	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU43-44	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SU45	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SU46-50	DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET
SU51-52	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU53-66	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SU67-76	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU77	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU78	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU79	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SX1	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
U1	AD584	No description found in cross ref file	
U2-6	RV MFT 7104D-419-102	No description found in cross ref file	
U7-10	25LS2521	IC	8 BIT COMPARATOR
U11	74LS08	IC	QUAD 2-INPUT AND GATE
U12-15	25LS2521	IC	8 BIT COMPARATOR
U16	MC34002	IC	DUAL FET OP AMP
U17-18	AD7581	No description found in cross ref file	
U19-22	74LS377	IC	OCTAL REGISTER WITH ENABLE
U23	74LS08	IC	QUAD 2-INPUT AND GATE
U24-27	74LS377	IC	OCTAL REGISTER WITH ENABLE
U28	74LS32	IC	QUAD 2-INPUT OR GATE
U29	74LS74A	IC	DUAL D FLIP-FLOP
U30	74LS04	IC	HEX INVERTER
U31	74LS164	IC	8 BIT SERIAL IN/ PARALLEL OUT REGISTER
U32	74LS169	No description found in cross ref file	
U33	74LS174	No description found in cross ref file	
U34	PAL10L8	No description found in cross ref file	
U35	74LS138	IC	3-TO-8 LINE DECODER
U36-37	74LS245	IC	OCTAL BUS TRANCIEVER
U38	74LS377	IC	OCTAL REGISTER WITH ENABLE
U39	74LS373	IC	OCTAL TRI-STATE LATCH
U40	74LS260	IC	DUAL 5-INPUT NOR GATE
U41	74LS377	IC	OCTAL REGISTER WITH ENABLE
U42	74LS373	IC	OCTAL TRI-STATE LATCH
U43	74LS08	IC	QUAD 2-INPUT AND GATE
U44	74LS04	IC	HEX INVERTER

Reference No's	Part Name	Part Type	Description
U45	MC68230L8	No description found in cross ref file	
U46-49	2661-3N	No description found in cross ref file	
U50	AM9519A-1	IC	INTERRUPT CONTROLLER
U51	AM27S28	No description found in cross ref file	
U52	74LS240	IC	OCTAL BUS DRIVER
U53	74LS08	IC	QUAD 2-INPUT AND GATE
U54	74LS74A	IC	DUAL D FLIP-FLOP
U55	74LS04	IC	HEX INVERTER
U56	74LS02	IC	QUAD 2-INPUT NOR GATE
U57	74LS20	IC	DUAL 4-INPUT NAND GATE
U58-59	74LS00	IC	QUAD 2-INPUT NAND GATE
U60	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U61	DS1489A	No description found in cross ref file	
U62	DS1488	No description found in cross ref file	
U63	DS1489A	No description found in cross ref file	
U64	DS1488	No description found in cross ref file	
U65	DS1489A	No description found in cross ref file	
U66	DS1488	No description found in cross ref file	
U67	74LS245	IC	OCTAL BUS TRANCIEVER
U68-72	74LS240	IC	OCTAL BUS DRIVER
U73-74	25LS2521	IC	8 BIT COMPARATOR
U75	27S28	No description found in cross ref file	
U76	74LS240	IC	OCTAL BUS DRIVER
U77	74LS138	IC	3-TO-8 LINE DECODER
U78	PAL16R4	IC	16R4 PAL LOGIC ARRAY
VR1	LM320T	No description found in cross ref file	

VCC

Component List for VCC100A

Reference No's	Total	Part Name	Part Type	Description
C1	1	C 2.2UF 25V TAN	No description found in cross ref file	
C2	1	C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR
C3	1	C .01UF 50V CER	CAPACITOR	.01 UF CERAMIC CAPACITOR
C4-18	15	C ?	No description found in cross ref file	
C19	1	C 100UF 20V TAN	CAPACITOR	100 UF 20V TANTALUM CAPACITOR
C20-26	7	C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR
J1-3	3	J SCOTCHFLEX 40-RAST	JACK	40 PIN RIGHT ANGLE SOLDER TAIL HEADER
R1,8,11	3	R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR
R2	1	R 1 OHM 1/2W 1%	RESISTOR	1 OHM 1/2W 1% RESISTOR
R3,16	2	R 56K OHM 1/4W 2%	No description found in cross ref file	
R4,15	2	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
R5	1	R 27.4K OHM 1/4W 2%	RESISTOR	27.4K OHM 1/4W 2% RESISTOR
R6,13	2	R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR
R7,12	2	R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR
R14	1	R 27K OHM 1/4W 2%	No description found in cross ref file	
RP1-2,5-6	4	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
RP3-4	2	RP 27K OHM SIP-10	No description found in cross ref file	
RV9-10	2	RV 20K BOURNS 3299	No description found in cross ref file	
S1	1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
S2	1	SW DIP-4	SWITCH	4 POSITION DIP SWITCH
SU1	1	RND SOCKET-8 ST	SOCKET	8 PIN SOLDER TAIL ROUND SOCKET
SU2-6,32-33,35,77	9	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SU7-10,12-15,19-22, 24-27,34,36-39, 41-42,51-52,67-76, 78	36	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SU11,23,28-31,40, 43-44,53-66,SX1	24	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET
SU16	1	DIP SOCKET-8 ST	No description found in cross ref file	

Reference No's	Total	Part Name	Part Type	Description
SU17-18,46-50	7	DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET
SU45,79	2	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
U1	1	AD584	No description found in cross ref file	
U2-6	5	RV MFT 7104D-419-102	No description found in cross ref file	
U7-10,12-15,73-74	10	25LS2521	IC	8 BIT COMPARATOR
U11,23,43,53	4	74LS08	IC	QUAD 2-INPUT AND GATE
U16	1	MC34002	IC	DUAL FET OP AMP
U17-18	2	AD7581	No description found in cross ref file	
U19-22,24-27,38,41	10	74LS377	IC	OCTAL REGISTER WITH ENABLE
U28	1	74LS32	IC	QUAD 2-INPUT OR GATE
U29,54	2	74LS74A	IC	DUAL D FLIP-FLOP
U30,44,55	3	74LS04	IC	HEX INVERTER
U31	1	74LS164	IC	8 BIT SERIAL IN/ PARALLEL OUT REGISTER
U32	1	74LS169	No description found in cross ref file	
U33	1	74LS174	No description found in cross ref file	
U34	1	PAL10L8	No description found in cross ref file	
U35,77	2	74LS138	IC	3-TO-8 LINE DECODER
U36-37,67	3	74LS245	IC	OCTAL BUS TRANCIEVER
U39,42	2	74LS373	IC	OCTAL TRI-STATE LATCH
U40	1	74LS260	IC	DUAL 5-INPUT NOR GATE
U45	1	MC68230L8	No description found in cross ref file	
U46-49	4	2661-3N	No description found in cross ref file	
U50	1	AM9519A-1	IC	INTERRUPT CONTROLLER
U51	1	AM27S28	No description found in cross ref file	
U52,68-72,76	7	74LS240	IC	OCTAL BUS DRIVER
U56	1	74LS02	IC	QUAD 2-INPUT NOR GATE
U57	1	74LS20	IC	DUAL 4-INPUT NAND GATE

Reference No's	Total	Part Name	Part Type	Description
U58-59	2	74LS00	IC	QUAD 2-INPUT NAND GATE
U60	1	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U61,63,65	3	DS1489A	No description found in cross ref file	
U62,64,66	3	DS1488	No description found in cross ref file	
U75	1	27S28	No description found in cross ref file	
U78	1	PAL16R4	IC	16R4 PAL LOGIC ARRAY
VR1	1	LM320T	No description found in cross ref file	

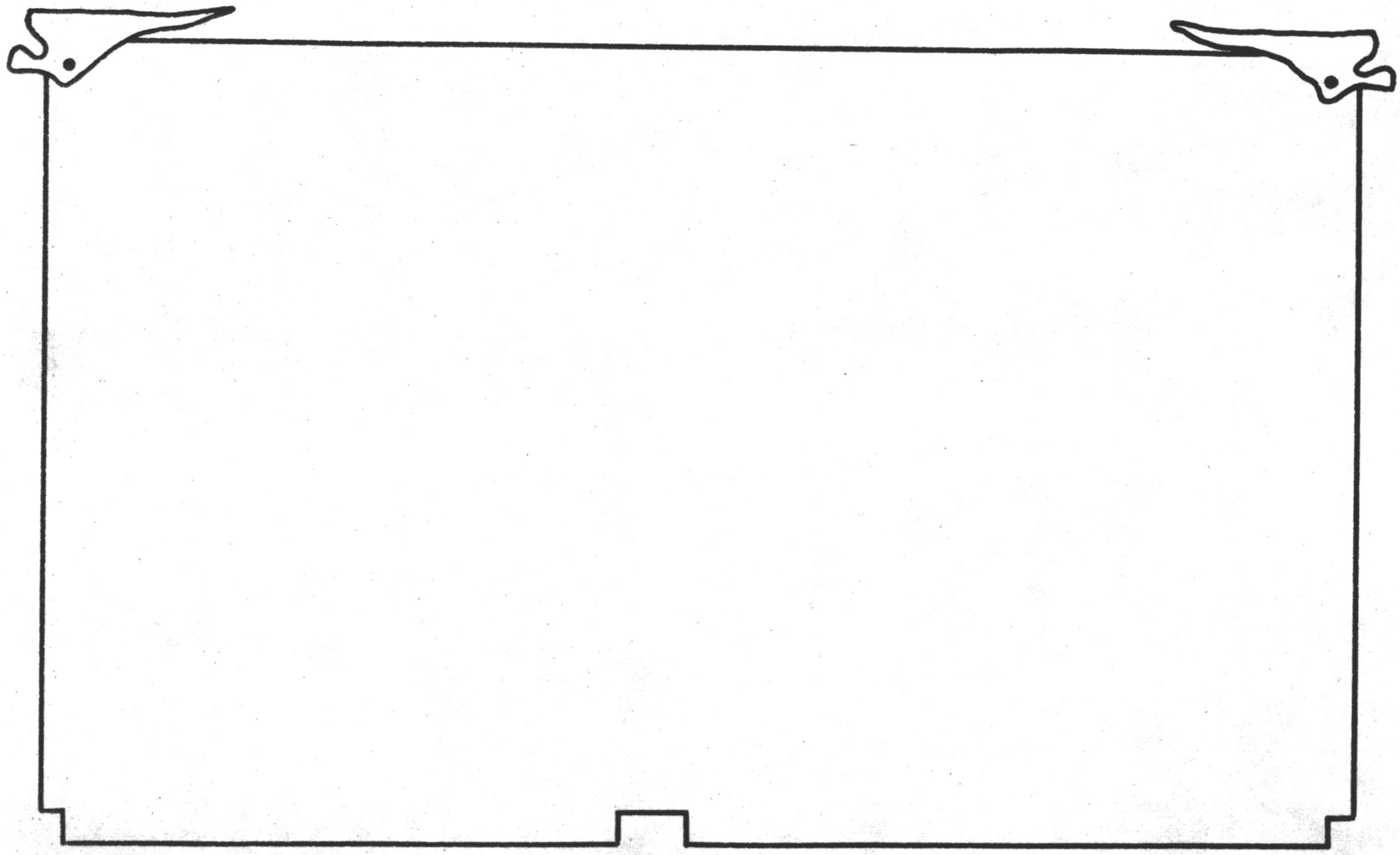
Reference No's	Total	Part Name	Part Type	Description
J1-2	2	J SCOTCHFLEX 60-RAWW	JACK	60 PIN RIGHT ANGLE WIRE WRAP HEADER
RP1-2	2	R 3.3K OHM DIP-14	No description found in cross ref file	
SW1-2	2	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
SW3	1	SW DIP-6	SWITCH	6 POSITION DIP SWITCH
U1-4,9-12	8	74LS153	IC	DUAL 4 TO 1 LINE MULTIPLEXERS
U5-8,13-16	8	74LS377	IC	OCTAL REGISTER WITH ENABLE
U17	1	74LS20	IC	DUAL 4-INPUT NAND GATE
U18-19	2	74LS175	IC	QUAD REGISTER W/CLEAR
U20	1	74LS04	IC	HEX INVERTER
U21	1	74LS139	IC	DUAL 2-4 LINE DECODER
U22	1	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
U23	1	74LS32	IC	QUAD 2-INPUT OR GATE
U24	1	74LS10	IC	TRIPLE 3-INPUT NAND GATE
U25-28	4	25LS2521	IC	8 BIT COMPARATOR
U29-30,38	3	74LS240	IC	OCTAL BUS DRIVER
U31-32	2	74S240	IC	OCTAL BUS DRIVER

1412

SUGGESTED REVISION TO <u>VCC</u>

1. SHEET A1 - NAME 'AS*' After 74LS240 to 'AS'
2. SHEET B1 - ON U31 : OUTPUT of U28 to PIN 1 of U31 ONLY
   - 'BRD_SEL' SIGNAL to PIN 2 of U31, (keep connection to U34)
   - 'AS' from 1 to PIN 9 of U31 (CLR)

BOARD ____________________ VER. ____________________



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P2 P1

FROM: Jim Ryan DATE: 1/13/83

SUBJECT: DISPLAY BOARD INTERFACE BUFFERS PAGE: 1

The addresses of the display board buffers used for message communication between the host and the display processors have been changed.

The NEW display processor to host message buffer addresses are:

		VDG 0	VDG 1	VDG2
Buffer	0	$E00400	$E01400	$E02400
	1	$E00480	$E01480	$E02480
	2	$E00500	$E01500	$E02500
	3	$E00580	$E01580	$E02580

The NEW host to display processor message buffer addresses are:

		VDG 0	VDG 1	VDG 2
Buffer	0	$E00000	$E01000	$E02000

This notebook entry supercedes "DISPLAY BOARD TO HOST INTERFACE" entry dated 1/3/83.

VDG 6809 Memory Map

0000 - 07BF	SHARED RAM
07C0 - 07C1	FOREGROUND CONTROLLER
07C2 - 07C3	BACKGROUND CONTROLLER
07C4 - 07C7	PIA 1
07C8 - 07CB	PIA 2
07CC - 07CF	PIA 3
07D0 - 07DF	LEFT CURSOR RAM
07E0 - 07EF	RIGHT CURSOR RAM
07F0 - 07FF	NOT USED
0800 - FFFF	RAM/ROM

(1)

GDC Initialization

30.88 MHz

MODES = 1) Character
2) Interlaced
3) Static RAM
4) Retrace update only

1FF

Active Words/Line = 90

510
256
255

HFP = 4 Chars 5
HS = 5 Chars 5
HBP = 5 Chars 4

Active Lines/Field = 384

VFP = 3 Lines
VS = 3 Lines
VBP = 22 Lines

256
31 / 256 / 7480 / 7836 / 255 / 8091

VDG GDC Commands

1) RESET -

ØØ		COMMAND
39h	P1:	modes
54h	P2:	CHARS/LINE -2
64h	P3:	VS_L, HS-1
1Øh	P4:	HFP-1, VS_H
Ø7h	P5:	HBP-1
Ø3h	P6:	VFP
8Øh	P7:	$LINES/FIELD_L$
59h	P8:	VBP, $LINES/FIELD_H$

2) VSYNC MODE -

6E	SLAVE MODE
6F	MASTER MODE

3) CURSOR/CHAR CHARACTERISTICS

4Bh		COMMAND
ØFh	P1:	DC, LINES/CHAR-1
Ø1h	P2:	BR_L, SC, CTOP
ØØh	P3:	CBOT, BR_H

C) Cursor & Character Characteristics

Command = 4Bh

P1 = ØF (DC, Lines/Char -1)

P2 = ØØ (Ø1) (BR$_L$, SC, CTOP) ≡ NON-BLINK
6Ø (61) ≡ BLINK

P3 = ØØ (CBOT, BR$_H$)

D) START

Command = 6Bh

E) PITCH

Command = 47h

P1 = 5Ah (90 chars/Row)

F) Parameter RAM Load

Command = 7Øh

P1 = Ø (SAD1$_L$)
P2 = Ø (SAD1$_H$)
P3 = Ø (LEN1$_L$)
P4 = 1Ø (WD1, LEN1$_H$)

32.50
6
194.25

Monitor Parameters

(30.88 MHz)

32.38 ns / Pixel

388.6 ns / char

5 μs retrace

40.4 μsec / line

35.0 μsec unblanked

1.55 μsec HFP (4 chars)

1.94 μsec HS (5 chars) 4

1.94 μsec HBP (5 chars) 9

5.44 μsec blanked

104 chars / line total

412 lines / field

384 lines visible

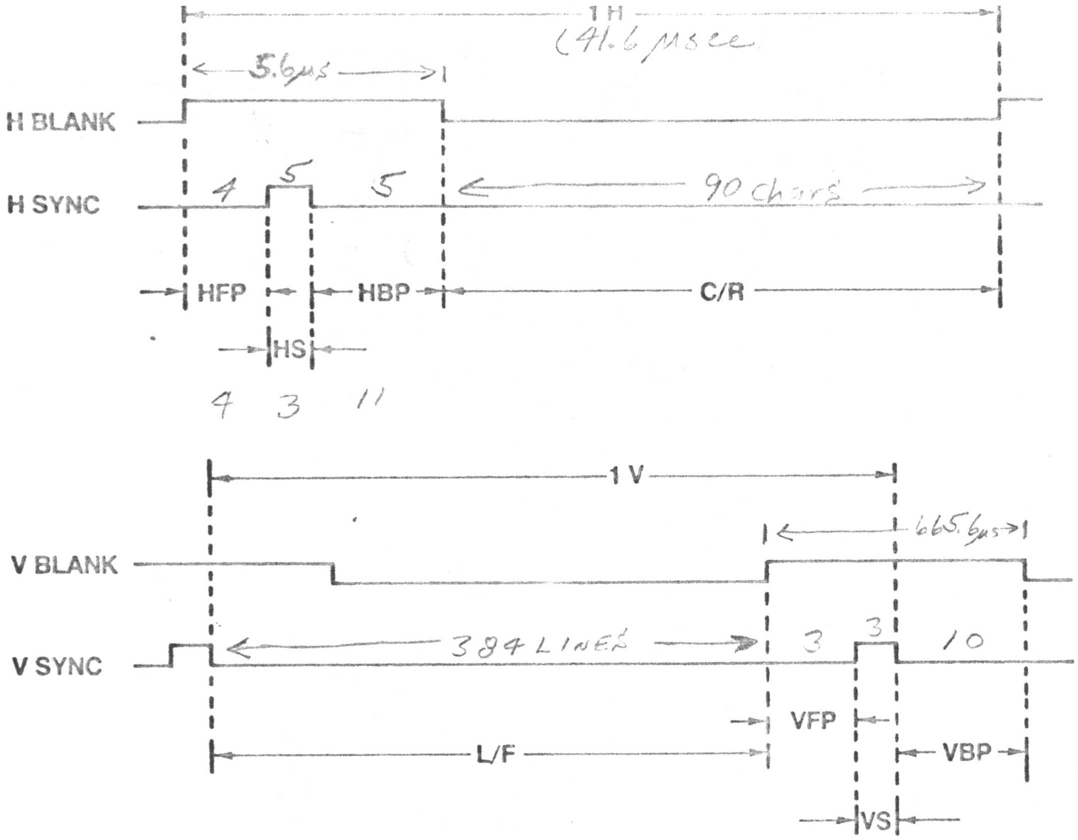
28 lines blanked

1131.2 μsec blanked

121.2 μsec VFP (3 lines)

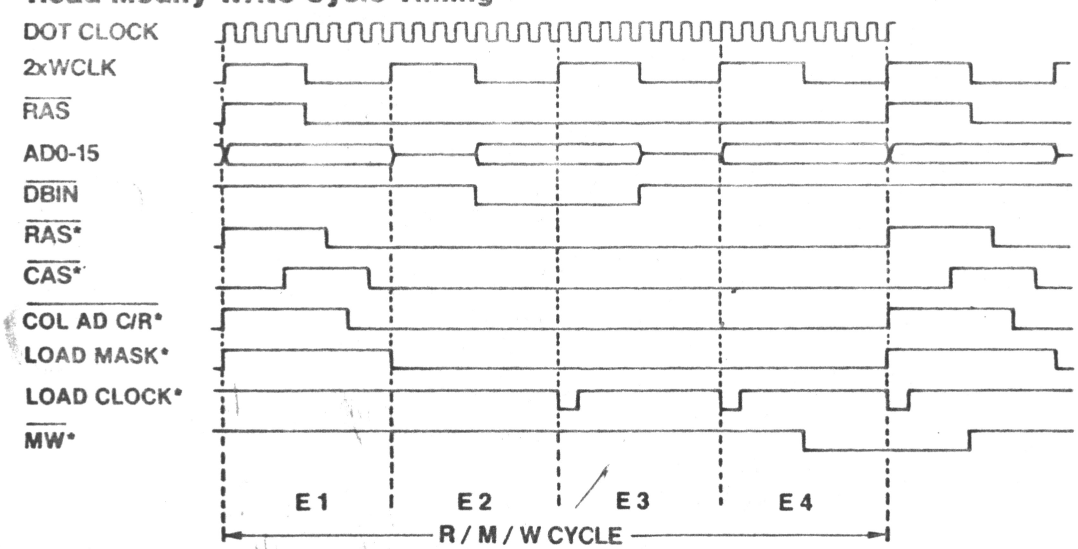
121.2 μsec VS (3 lines)

888.8 μsec VBP (22 lines)



Video Sync Generator Parameters

Read-Modify-Write Cycle Timing



***externally generated signals**

617 655 8833

VDG

This file contains the fixes to be made on VDG100A. All these corrections should be made to version 'A' of the display generator.

1) Problem: Reset push-button switch holes and connections were layed out wrong.

Fix: Wire push button switch descretely:

```
                          O         O        Mounting Holes


                    (1)       (2)       (3)
                     O         O         O
                    (NC)      (COM)     (NO)
```

Hole 1 should be connected to the Normally Connected switch contac
Hole 2 should be connected to the Common switch contact.
Hole 3 should be connected to the Normally Open switch contact.

2) Problem: SYSRESET* was taken off the wrong VERSAbus pin on the first drawing.

Fix: Cut wire by UC7-6 on solder side.
Check between UC7-6 and P1-89 for open.
Solder jumper from P1-74 to UC7-6.

3) Problem: LB_A00 - LB_A04 were connected to the peripheral address decoder instead of LB_A01 - LB_A05.

Fix: Cut wire on BOTH sides of UA8-10 on solder side.
Solder jumper from UA18-10 to UA20-36.
Solder jumper from UB15-19 to UA8-10.

4) Problem: Because of problem 3, LB_A05 has to be disconnected from comparator UA7.

Fix: Cut BOTH wires coming from UA7-7 on solder side.
Solder jumper from UA4-7 to UB15-19.
Solder jumper from UA7-6 to UA7-7.

5) Problem: VB_DS0 was made into SB_A00 instead of VB_DS1.

Fix: Cut wire by UC6-4 on solder side.
Cut wire by UC6-4 on component side.
Solder jumper from UC7-3 to UB4-4.
Solder jumper from UC7-5 to UC6-4.

6) Problem: The 'K' inputs to UG11-12, UG12-2 and UG12-12 were left open.

Fix: Solder jumper from UG11-8 to UG11-12.
Solder jumper from UG12-8 to UG12-2.
Solder jumper from UG12-6 to UG12-12.

7) Problem: The CLOCK and CLEAR inputs to all 74S299's were reversed.

Fix: Cut wire on BOTH sides of UB9-9 on component side.
Check between UB9-9 and UD16-11 for open.
Check between UB9-9 and UB10-9 for open.
Cut wire on BELOW side of UB10-9 on component side.
Check between UB10-9 and UC13-2 for open.

Check between UB9-12 and UB2-1 for open.
Cut wire by UB10-12 on solder side.
Check between UB10-12 and UB7-3 for open.
Solder jumper from UB9-12 to UB10-12.
Solder jumper from UB10-12 to UC13-2.
Solder jumper from UB9-9 to UB2-1.
Solder jumper from UB10-9 to UB7-3.

Cut wire on LEFT side of UF2-9 on solder side.
Check between UF2-9 and UF4-9 for open.
Cut wire on LEFT side of UF6-9 on solder side.
Check between UF6-9 and UF8-9 for open.
Cut wire by UF1-12 on solder side.
Check between UF1-12 and UF1-1 for open.
Cut wire by UF5-12 on component side.
Check between UF5-12 and UF5-1 for open.
Solder jumper from UF4-9 to UF1-12.
Solder jumper from UF1-12 to UF5-12.
Solder jumper from UF5-12 to UF8-9.
Solder jumper from UF1-3 to UF1-9.

Cut wire by UG25-9 on solder side.
Check between UG25-9 and UE21-11 for open.
Cut wire by UG24-12 on solder side.
ERR Check between UG24-12 and UE24-3 for open. UG24-3
Solder jumper from UG24-3 to UG24-9.

8) Problem: 30MHz clock signal had to be redistributed and buffered.

Fix: Cut wire BELOW UE26-9 on solder side.
Check between UE26-9 and UE16-11 for open.
Cut wire on RIGHT side of UE21-11 on component side.
Check between UE21-11 and UG9-2 for open.
Cut wire on LEFT side of UE15-11 on component side.
Check between UE15-11 and UG15-2 for open.
Solder jumper from UE26-9 to UD26-9.
Solder jumper from UD26-7 to UD26-10.
Solder jumper from UD26-8 to UF1-12.
Solder jumper from UE15-11 to UE21-11.
Solder jumper from UE16-11 to UD16-11.

Cut wire by UE16-1 on component side.
Check between UE16-1 and UC11-5.
ERR Cut wire on RIGHT side of UD26-1 on solder side. UE26-1
Check between UD26-1 and UD16-1. UE26-1
Cut wire on RIGHT side of UD22-1 on solder side.
Check between UD22-1 and UF3-1.
Cut wire on RIGHT side of UE21-1 on solder side.
Check between UE21-1 and UF7-1.
Solder jumper from UE16-1 to UE16-10.
ERR Solder jumper from UD16-1 to UE16-10.
Solder jumper from UD26-1 to UE16-11. UE26-1
Solder jumper from UE21-11 to UF7-1.
Solder jumper from UD22-11 to UF3-1.

Solder jumper from UG9-2 to UG25-12.
Solder jumper from UC16-3 to UG7-13.
Solder jumper from UG7-12 to UG7-7.
Solder jumper from UG7-11 to UG9-2.

9) Problem: Cursor horizontal comparators had a glitch.

Fix: Cut wire BELOW UG22-2 on solder side.
Check between UG22-2 and UB3-4 for open.

Check between UG20-2 and UF17-7 for open.
Solder jumper from UF17-7 to UB3-4.

Cut wire by UG18-1 on solder side.
Check between UG18-1 and UF16-2 for open.
Solder jumper from UG18-1 to UG15-1.
Solder jumper from UF17-2 to UG20-2.

10) Problem: The line counter LSB has an undocumented glitch during horizontal retrace that screws up the cursor logic on odd lines.

Fix: Cut wire on RIGHT side of UG19-10 on solder side.
Check between UG19-10 and UE2-19 for open.

Solder jumper from UE2-19 to UB8-3.
Solder jumper from UB8-3 to UB7-13.
? Solder jumper from UB7-13 to UB8-2. ?
Solder jumper from UE26-7 to UB8-1.
Solder jumper from UB8-20 to UB8-17.
Solder jumper from UB8-19 to UB8-4.
? Solder jumper from UB8-10 to UB8-8.
Solder jumper from UB8-5 to UG19-10.

11) Problem: The slave controller must only set the even fields to sync correctly to the master.

Fix: Cut wire by UD1-4 on solder side.
Check between UD1-4 and UE1-4 for open.
Solder jumper from UB6-8 to UD1-4.
? Solder jumper from UB6-9 to UB8-4.
Solder jumper from UB6-10 to UE26-12.
Solder jumper from UB6-11 to UB6-14.

12) Problem: UB-24 doesn't have POWER and GROUND connections.

Fix: Solder jumper from UB24-14 to UB11-14.
Solder jumper from UB24-7 to UB11-7.

13) Problem: Multi-wire connected 'D0' of the 6809 to the Direction input of UA2.

Fix: Cut wire by UA2-1 on solder side.
Check between UA2-1 and UA1-31 for open.
Solder jumper from UA2-2 to UA1-31.
Solder jumper from UA12-4 to UA2-1.

14) Problem: Multi-wire tied UB23-2 and UB23-14 to 'LB_D1' instead of 'LB_D7'.

Fix: Cut wire on RIGHT side of UB23-2 on solder side.
Check between UB23-2 and UB17-14 for open.
Cut wire on BOTTOM side of UB23-14 on solder side.
Check between UB23-14 and UA19-12 for open.
Solder jumper from UB17-14 to UA19-12.
Solder jumper from UA2-11 to UB23-2.

15) Problem: Multi-wire forgot to wire UB22-12 to UB23-12.

Fix: Solder jumper from UB22-12 to UB23-12.

16) Problem: Multi-wire forgot to wire UE7-11 to UE21-7.

Fix: Solder jumper from UE7-11 to UE21-7.

Fix: Solder jumper from UD20-9 to UD21-9.
Solder jumper from UD20-10 to UD21-10.
Solder jumper from UD20-11 to UD21-11.
Solder jumper from UD20-13 to UD21-13.
Solder jumper from UD20-14 to UD21-14.
Solder jumper from UD20-15 to UD21-15.
Solder jumper from UD20-16 to UD21-16.
Solder jumper from UD20-17 to UD21-17.

18) Problem: WE* on the static RAMs was implemented incorrectly.

Fix: Cut wire by UD7-8 on component side.
ERR Check between UD7-8 and UD15-20 for open. UD15-21
Cut wire by UE5-8 on solder side.
Check between UE5-8 and UE14-20 for open. UE14-21
Solder jumper from UD7-8 to UA14-9.
Solder jumper from UA14-13 to UA14-10.
Solder jumper from UA14-8 to UD11-21.
Solder jumper from UE5-8 to UA14-12.
Solder jumper from UE5-3 to UA14-13.
Solder jumper from UA14-11 to UE14-21.

19) Problem: UF12 and UF13 had pins 3,4,5 and 6 reversed as inputs.

Fix: Cut wire by UF4-10 on component side BENEATH THE adhesive layer.
Check between UF4-10 and UF12-4 for open.
Cut wire by UA21-12 on component side.
Check between UA21-12 and UF12-3 for open.
Cut wire by UF12-5 on component side.
Check between UF12-5 and UF8-10 for open.
Cut wire by UF13-5 on component side.
Check between UF13-5 and UF8-2 for open.
Cut wire by UF12-6 on solder side.
Check between UF12-6 and UA21-16 for open.
Cut wire by UF13-3 on solder side.
Check between UF13-3 and UA21-10 for open.
Cut wire by UF13-6 on solder side.
ERR Check between UF13-6 and UA21-14 for open.
Solder jumper from UF12-3 to UA21-16.
Solder jumper from UF12-4 to UF8-10.
Solder jumper from UF12-5 to UF4-10.
Solder jumper from UF12-6 to UA21-12.
Solder jumper from UF13-3 to UA21-14.
Solder jumper from UF13-4 to UF8-2.
? Solder jumper from UF13-5 to UF4-2.
Solder jumper from UF13-6 to UA21-10.

20) Problem: Multi-wire tied UF4-1 to UF4-16 instead of UF4-8.

Fix: Cut wire by UF4-1 on solder side.
Check between UF4-1 and UF4-16 for open.
Solder jumper from UF4-1 to UF4-8.

Reference No's	Total	Part Name	Part Type	Description
C1	1	C 100UF 20V TAN	CAPACITOR	100 UF 20V TANTALUM CAPACITOR
C2-4	3	C 47UF 20V TAN	CAPACITOR	47 UF 20V TANTALUM CAPACITOR
CA1-15, CB1-20, CC1-15, CD1-22, CE1-23, CF1-17, CG1-22	134	C .1UF 50V CER .25S	CAPACITOR	.1 UF 50V CERAMIC CAPACITOR
J1-4	4	COAX-CONN	CONNECTOR	Amphenol #901-143 Coax-connector
JB1	1	JB-14	JUMPER BLK	14 PIN JUMPER BLK
JB2	1	JB-2	JUMPER BLK	2 PIN JUMPER BLK
JB3	1	JB-4	JUMPER BLK	4 PIN JUMBER BLOCK
PB1	1	SW PB SPDT	SWITCH	SPDT PUSH-BUTTON SWITCH
QF1-3	3	2N3509	TRANSISTOR	SWITCHING TRANSISTOR
RC2-3	2	R 2K OHM 1/4W 2%	RESISTOR	2K OHM 1/4W 2% RESISTOR
RD1, RE1, RF1-2, 11	5	R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR
RF4, 6, 8	3	R 150 OHM 1/4W 2%	RESISTOR	150 1/4W 2% RESISTOR
RF5, 7, 9-10	4	R 75 OHM 1/4W 2%	RESISTOR	75 1/4W 2% RESISTOR
RPA1-3, RPC1-2	5	RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK
RPG1	1	RP 1K OHM SIP-6	RES NET	1K OHM 6 PIN SIP RESISTOR NETWORK
SQF1-3	3	RND SOCKET-3 ST	SOCKET	3 PIN SOLDER TAIL ROUND SOCKET
SUA1, 20-22, SUD1, SUE1	6	DIP SOCKET-40 ST	SOCKET	40 PIN SOLDER TAIL DIP SOCKET
SUA2-7, SUB8-10, 12-14, SUC1-10, SUD2-3, 16-17, 22, SUE2-3, 15-16, 21, SUF1-2, 5-6, SUG13-14, 18, 24-25	41	DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET
SUA8, SUB2, 16-23, SUC13-15, 17-18, SUD5, SUE26, SUF3-4, 7-14, 17, SUG2-6, 8-9, 11-12, 15-17, 19-22, 26	45	DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET
SUA9-17, SUB3-7, 11, 24, SUC11-12, 16, SUD4, 6-7, 23-26, SUE4-6,	38	DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET

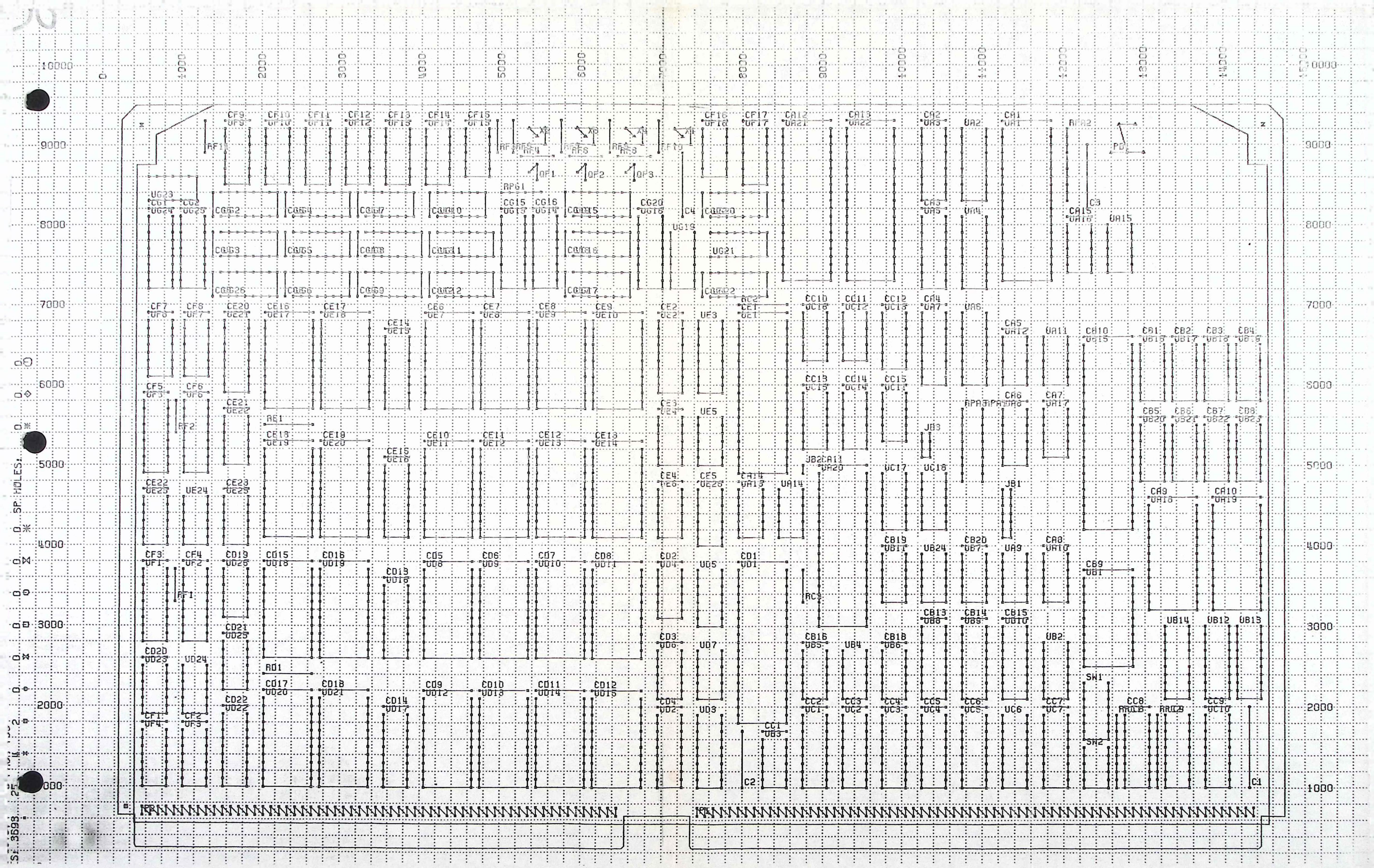
Reference No's	Total	Part Name	Part Type	Description
22-25,SUF15-16,SUG7,10,23				
SUA18-19	2	DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET
SUB1,SUD8-15,18-21,SUE7-14,17-20	25	DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET
SUB15	1	DIP SOCKET-48 ST	SOCKET	48 PIN SOLDER TAIL DIP SOCKET (2-24 PIN)
SW1	1	SW DIP-8	SWITCH	8 POSITION DIP SWITCH
SW2	1	SW DIP-6	SWITCH	6 POSITION DIP SWITCH
UA1	1	MC68B09	IC	2 MHZ 6809 MICRO-PROCESSOR
UA2,UB14	2	74LS245	IC	OCTAL BUS TRANCIEVER
UA3-5,UB12-13	5	74LS244	IC	OCTAL BUS DRIVER
UA6-7,UC8-10,UG18	6	25LS2521	IC	8 BIT COMPARATOR
UA8	1	74S188	IC	32X8 PROM
UA9,UB5	2	74LS20	IC	DUAL 4-INPUT NAND GATE
UA10,UB4	2	74LS10	IC	TRIPLE 3-INPUT NAND GATE
UA11,13,UB24	3	74LS32	IC	QUAD 2-INPUT OR GATE
UA12,UB7	2	74LS04	IC	HEX INVERTER
UA14-15,UE25	3	74LS00	IC	QUAD 2-INPUT NAND GATE
UA16,UB11,UG10	3	74S02	IC	QUAD 2-INPUT NOR GATE
UA17	1	74LS08	IC	QUAD 2-INPUT AND GATE
UA18-19	2	2716	IC	2KX8 EPROM
UA20-22	3	MC68B21	IC	2 MHZ PIA
UB1,UD8-15,UE7-14	17	TMM2016	IC	2KX8 STATIC RAM
UB2	1	74LS158	IC	QUAD 2-1 INV DATA MULTIPLEXERS
UB3	1	74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT
UB6	1	74LS11	IC	TRIPLE 3-INPUT AND GATE
UB9-10,UF1-2,5-6,UG24-25	8	74S299	IC	8 BIT SHIFT REGISTER

Reference No's	Total	Part Name	Part Type	Description
UB15	1	DP8408	IC	DYNAMIC RAM REFRESH CONTROLLER
UB16-23	8	MCM6665A-15	IC	150 ns 64K DYNAMIC RAM
UC1,3,5-7	5	74LS240	IC	OCTAL BUS DRIVER
UC2,4	2	74S240	IC	OCTAL BUS DRIVER
UC11,16	2	74S37	IC	QUAD 2-INPUT NAND BUFFERS
UC12	1	30MHZ OSC	OSCILLATOR	30 MHZ OSCILLATOR
UC13,UG9,15-17	5	74S161	IC	4-BIT COUNTER
UC14,UG8,12	3	74S112	IC	DUAL J-K FILP-FLOP
UC15	1	74S195	IC	4-BIT SHIFT REGISTER
UC17-18,UG6,20-22	6	74LS161	IC	4-BIT COUNTER
UD1,UE1	2	uPD7220	IC	GRAPHIC DISPLAY CONTROLLER
UD2-3,UE2-3	4	74LS373	IC	OCTAL TRI-STATE LATCH
UD4,UE6	2	74LS02	IC	QUAD 2-INPUT NOR GATE
UD5	1	74S139	IC	DUAL 2-TO-4 LINE DECODER
UD6-7,UE4-5	4	74LS74A	IC	DUAL D FLIP-FLOP
UD18-21,UE17-20	8	DM87S191	IC	2KX8 BIPOLAR PROM
UD23-26,UE22-24, UG23	8	74LS86	IC	QUAD 2-INPUT EXOR GATE
UE26,UF3-4,7-9,11, 14,17	9	25S08	IC	QUAD REGISTER W/ENABLE
UF10	1	74148	IC	8 BIT PRIORITY ENCODER
UF12-13	2	74S153	IC	DUAL 4-1 DATA MULTIPLEXERS
UF15	1	7433	IC	QUAD 2-INPUT NOR BUFFERS W/OC OUTPUTS
UF16	1	74128	IC	QUAD 50-OHM LINE DRIVER
UG2-5	4	74S189	IC	16X4 TTL RAM
UG7	1	74S32	IC	QUAD OR GATE
UG11	1	74LS112	IC	DUAL J-K FLIP-FLOP
UG13-14	2	74F521	IC	8 BIT COMPARATOR

Reference No's	Total	Part Name	Part Type	Description
UG19	1	74LS85	IC	4 BIT COMPARATOR
UG26	1	74LS157	IC	QUAD 2-1 DATA MULTIPLEXER

This file contains the programing for the address decoding PROM on the Video Display Board (VDG100A).

PROM-Adr	Data	Comments
00	FE	Character Controller
01	DF	Right Cursor Data
02	FD	Background Controller
03	DF	Right Cursor Data
04	FB	PIA 1
05	DF	Right Cursor Data
06	FB	PIA 1
07	DF	Right Cursor Data
08	F7	PIA 2
09	DF	Right Cursor Data
0A	F7	PIA 2
0B	DF	Right Cursor Data
0C	EF	PIA 3
0D	DF	Right Cursor Data
0E	EF	PIA 3
0F	DF	Right Cursor Data
10	BF	Left Cursor Data
11	FF	Invalid - Ignore
12	BF	Left Cursor Data
13	FF	Invalid - Ignore
14	BF	Left Cursor Data
15	FF	Invalid - Ignore
16	BF	Left Cursor Data
17	FF	Invalid - Ignore
18	BF	Left Cursor Data
19	FF	Invalid - Ignore
1A	BF	Left Cursor Data
1B	FF	Invalid - Ignore
1C	BF	Left Cursor Data
1D	FF	Invalid - Ignore
1E	BF	Left Cursor Data
1F	FF	Invalid - Ignore



0
1000
2000
3000
4000
5000
6000
8000
9000
10000
12000
13000
14000
SP. HOLES:

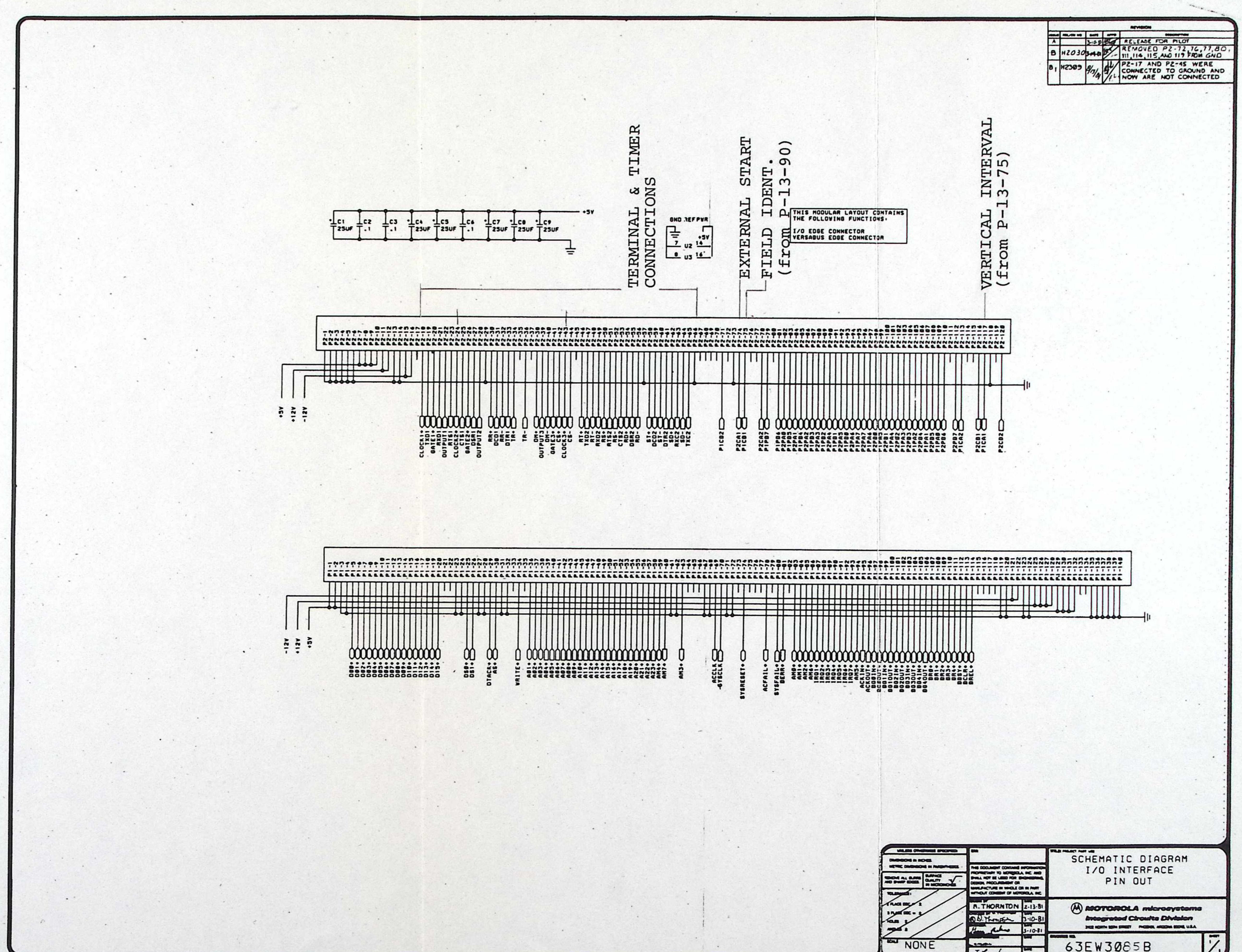


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FIGURE 6-53. M68KVM01A1 and A2, Edge Connector Pinouts Schematic Diagram

M68KDRAM(D2)
MICROSYSTEMS

SYSTEMS

M68K32DP/64DP/128DP
M68KVM10-1/-2/-3
32K/64K/128K Byte
Dynamic Memory Module
User's Guide

MOTOROLA

M68KDRAM(D2)

NOVEMBER 1981

M68K32DP/64DP/128DP

M68KVM10-1/-2/-3

32K/64K/128K BYTE DYNAMIC MEMORY MODULE

USER'S GUIDE

Second Edition

First Edition August 1980

SAFETY SUMMARY
SAFETY DEPENDS ON YOU

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Motorola Inc. assumes no liability for the customer's failure to comply with these requirements. The safety precautions listed below represent warnings of certain dangers of which we are aware. You, as the user of the product, should follow these warnings and all other safety precautions necessary for the safe operation of the equipment in your operating environment.

GROUND THE INSTRUMENT.
To minimize shock hazard, the equipment chassis and enclosure must be connected to an electrical ground. The equipment is supplied with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter, with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.
Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS.
Operating personnel must not remove equipment covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.
Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.
Breakage of the Cathode-Ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the equipment. Handling of the CRT should be done only by qualified maintenance personnel using approved safety mask and gloves.

DO NOT SUBSTITUTE PARTS OR MODIFY EQUIPMENT.
Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the equipment. Contact Motorola Microsystems Warranty and Repair for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS.
Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed. You should also employ all other safety precautions which you deem necessary for the operation of the equipment in your operating environment.

WARNING

Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing, and adjusting.

14260 PRINTED IN USA (6/81) MPS 300

PREFACE

Unless otherwise specified, all address references are in hexadecimal throughout this manual.

An asterisk (*) following the signal name for signals which are level significant denotes that the signal is true or valid when the signal is low.

An asterisk (*) following the signal name for signals which are edge significant denotes that the actions initiated by that signal occur on a high to low transition.

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LIST OF ILLUSTRATIONS

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CHAPTER 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

This manual provides general information, hardware preparation, functional description, and support information for the M68000 32K, 64K, and 128K Byte Dynamic Memory Modules.

1.2 FEATURES

The features of the memory module include:

32K Byte Dynamic Memory Module

- 262,144-bit storage capability (max.)
- 16,384 16-bit word storage capability

64K Byte Dynamic Memory Module

- 524,288-bit storage capability (max.)
- 32,768 16-bit word storage capability

128K Byte Dynamic Memory Module

- 1,048,576-bit storage capability (max.)
- 65,536 16-bit word storage capability

Common Memory Module Features

- Odd parity error detection
- RAM (Random Access Memory) disabling
- Switch selectable memory array base addressing
- Switch selectable memory array primary/secondary map selection
- Jumper selectable write cycle disabling
- Jumper selectable Read Only Memory Disable (ROMDIS*) signal enabling

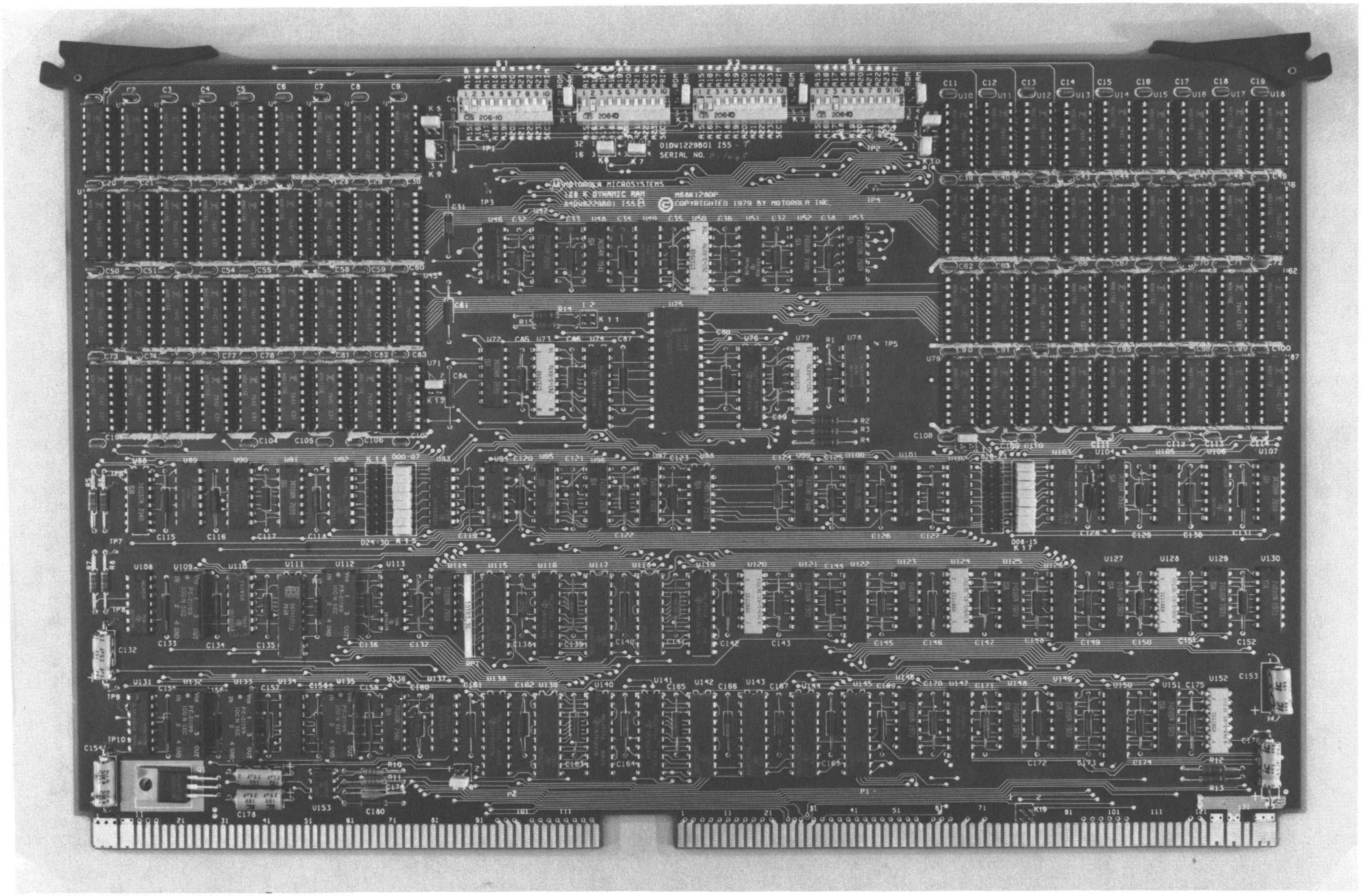


FIGURE 1-1. 128K Byte Dynamic Memory Module

1.3 SPECIFICATIONS

The 128K Byte Dynamic Memory Module specifications are identified in Table 1-1.

TABLE 1-1. Memory Module Specifications

CHARACTERISTIC	SPECIFICATIONS
Memory device type	MOS dynamic RAM (16,384 x 1)
Memory organization	16,384 x 16-bit words plus two parity bits
32K Byte	One memory row (16,384 words)
64K Byte	Two memory rows (32,768 words)
128K Byte	Four memory rows (65,536 words)
Parity check	Odd parity
Read cycle time	425 nanoseconds (max.)
Access time	390 nanoseconds (max.) from Data Strobe (DS*) to DTACK*
Error check time	Error check time is included in the access time of 390 nanoseconds
I/O signals	VERSAbus compatible
Temperature	
Operating	0° to $+65^{\circ}$ C
Storage	-40° to $+85^{\circ}$ C
Relative humidity	0 to 90% (non-condensing)
Power requirements	
32K Byte	+5 Vdc at 3.5 A (max.) standby
	+5 Vdc at 3.5 A (max.) operating
	+12 Vdc at 50 mA (max.) standby
	+12 Vdc at 650 mA (max.) operating
	-12 Vdc at 7.3 mA (max.) standby
	-12 Vdc at 9.1 mA (max.) operating
64K Byte	+5 Vdc at 3.5 A (max.) standby
	+5 Vdc at 3.5 A (max.) operating
	+12 Vdc at 80 mA (max.) standby
	+12 Vdc at 700 mA (max.) operating
	-12 Vdc at 7.3 mA (max.) standby
	-12 Vdc at 9.1 mA (max.) operating

TABLE 1-1. Memory Module Specifications (cont'd)

CHARACTERISTIC	SPECIFICATIONS
128K Byte	+5 Vdc at 3.5 A (max.) standby +5 Vdc at 3.5 A (max.) operating +12 Vdc at 148 mA (max.) standby +12 Vdc at 741 mA (max.) operating -12 Vdc at 7.3 mA (max.) standby -12 Vdc at 9.1 mA (max.) operating
Dimensions	
Height	9.25 inches (23.49 cm)
Width	14.50 inches (36.83 cm)
Thickness	0.6 inch (1.52 cm)

1.4 GENERAL DESCRIPTION

The 32K Byte Dynamic Memory Module consists of a single array (row) of 18 (16,384 x 1 bit) dynamic RAM devices. This single RAM array will accept 16,384 16-bit words and two parity bits. Each word consists of two 8-bit bytes, and each byte is assigned one parity bit (18 bits per row total). This memory array contains one base address and map select switch.

The 64K Byte Dynamic Memory Module consists of a double array (two rows) of 18 (16,384 x 1 bit) dynamic RAM devices. This double RAM array will accept 32,768 16-bit words and two parity bits. Each word consits of two 8-bit bytes, and each byte is assigned one parity bit (18 bits per row total). This memory array contains two base address and map select switches (one switch per row).

The 128K Byte Dynamic Memory Module consists of a quadruple array (four rows) of 18 (16,384 x 1 bit) dynamic RAM devices. This quadruple RAM array will accept 65,536 16-bit words and two parity bits. Each word consists of two 8-bit bytes, and each byte is assigned one parity bit (18 bits per row total). This memory array contains four base address and map select switches (one switch per row).

The memory modules are 16-bit word, 8-bit byte addressable. Base address and map select switches on all three memory modules permit the user to select base memory addresses in 16K-word/32K-byte increments, and to place the corresponding section of memory into the primary or secondary map operation.

Error detection circuitry of the memory module generates and detects odd parity. If a parity miscompare is detected, parity error signal (bus error) is generated and transferred to the system VERSAbus.

CHAPTER 2

HARDWARE PREPARATION

2.1 INTRODUCTION

This chapter provides hardware preparation procedures for the memory module.

2.2 UNPACKING INSTRUCTIONS

NOTE

> If shipping carton is damaged upon receipt, request carrier's agent be present during unpacking and inspection of the equipment.

Unpack equipment from shipping carton. Refer to packing list and verify that all items are present. Save packing material for storing or reshipping the equipment.

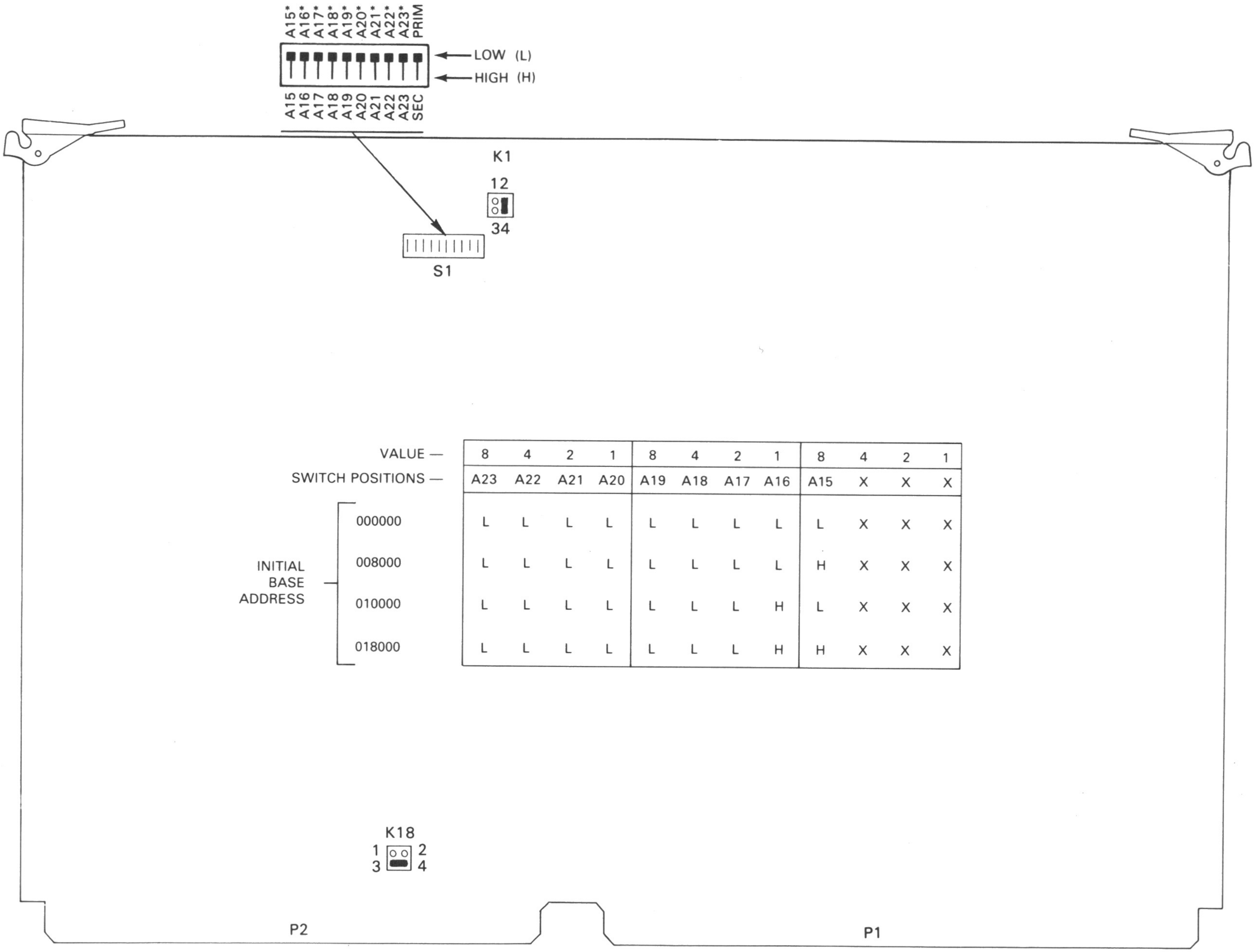
2.3 HARDWARE PREPARATION

This paragraph describes the preparation of memory module components prior to system installation. This description will ensure the user that his memory modue components are properly configured for system operation.

The 32K, 64K, and 128K Byte Dynamic Memory Modules have been factory tested for system operation, and are shipped with factory-installed jumpers and preset switch settings.

2.3.1 32K Byte Dynamic Memory Module

The 32K Byte Dynamic Memory Module should be inspected/prepared for jumper placements and switch settings prior to system installation. Figure 2-1 illustrates jumper header and switch locations applicable to this memory module. Jumper headers K1 and K18 provide write cycle disabling and ROMDIS* signal enabling, respectively. Switch S1 provides base address and map selection for the single row of RAM devices.



VALUE —	8	4	2	1	8	4	2	1	8	4	2	1
SWITCH POSITIONS —	A23	A22	A21	A20	A19	A18	A17	A16	A15	X	X	X
INITIAL BASE ADDRESS 000000	L	L	L	L	L	L	L	L	L	X	X	X
008000	L	L	L	L	L	L	L	L	H	X	X	X
010000	L	L	L	L	L	L	L	H	L	X	X	X
018000	L	L	L	L	L	L	L	H	H	X	X	X

FIGURE 2-1. 32K Byte Dynamic Memory Module, Jumper Header and Switch Locations

2.3.1.1 Write Cycle Disabling (K1). Jumper header K1 allows the user to disable the write cycle operation of the memory array (row). This function has no effect on the memory array read cycle operation.

JUMPER HEADER	PINS CONNECTED	REMARKS
K1	1 to 3	Write cycle disabled
K1	2 to 4 (1)	Write cycle enabled
NOTE: (1) Initial factory jumper placement.		

2.3.1.2 Configured Jumper Headers (K2-K17). Jumper headers K2 through K17 are factory configured and must not be removed or altered. Jumper header configurations are as follows:

JUMPER HEADER	PINS CONNECTED	JUMPER POSITION
K2	2 to 4	Vertical
K3	2 to 4	Vertical
K4	2 to 4	Vertical
K5	1 to 2	Horizontal
K6	3 to 4	Vertical
K7	3 to 4	Vertical
K8	1 to 2	Horizontal
K9	1 to 3	Vertical
K10	1 to 3	Vertical
K11	1 to 2	Horizontal
K11	3 to 4	Horizontal
K12	1 to 2	Horizontal
K13	1 to 2	Horizontal
K14	None	--
K15	1 to 2	Horizontal
	3 to 4	Horizontal
	5 to 6	Horizontal
	7 to 8	Horizontal
	9 to 10	Horizontal
	11 to 12	Horizontal
	13 to 14	Horizontal
K15	15 to 16	Horizontal
K16	None	--
K17	1 to 2	Horizontal
	3 to 4	Horizontal
	5 to 6	Horizontal
	7 to 8	Horizontal
	9 to 10	Horizontal
	11 to 12	Horizontal
	13 to 14	Horizontal
K17	15 to 16	Horizontal

2.3.1.3 ROMDIS* Signal Enabling (K18). Jumper header K18 allows the user to enable the ROM disable function of the memory module. When the ROM disable function is enabled, the memory module (when addressed) generates a low level ROMDIS* signal. This signal will disable all system ROM at the same memory module address location, thus allowing the memory module to respond to the ROM address.

JUMPER HEADER	PINS CONNECTED	REMARKS
K18	1 to 2	ROMDIS* signal enabled
K18	3 to 4 (1)	ROMDIS* signal disabled

NOTE:

(1) Initial factory jumper placement.

2.3.1.4 Configured Wire Wrap Header (K19). Jumper header K19 is factory wire wrap jumpered between pins 1 and 4, and must not be removed or altered.

2.3.1.5 Base Address and Map Selection (S1). The base address and map select switch S1 allows the user to establish the memory array (row) initial address, and to place the array into the primary or secondary map operation. This switch is a Dual In-line Package (DIP) switch which contains ten 2-position slide switches.

When set, the address positions (A15 and A15* through A23 and A23*) enable the memory module to operate within a 16K continuous address range, beginning at the initial address setting.

When set, the map selection positions (PRIM and SEC) enable the memory module to operate in either the primary (PRIM) or the secondary (SEC) map.

The initial factory switch settings are as follows:

POSITIONS ACTIVATED	ADDRESS RANGE	OPERATING MAP
A15*-A23*, and PRIM	000000-007FFF	Primary

The above switch settings allow the memory module to operate in the primary map, with 16,384 continuous-word (32,768 continuous-byte) addressable locations available.

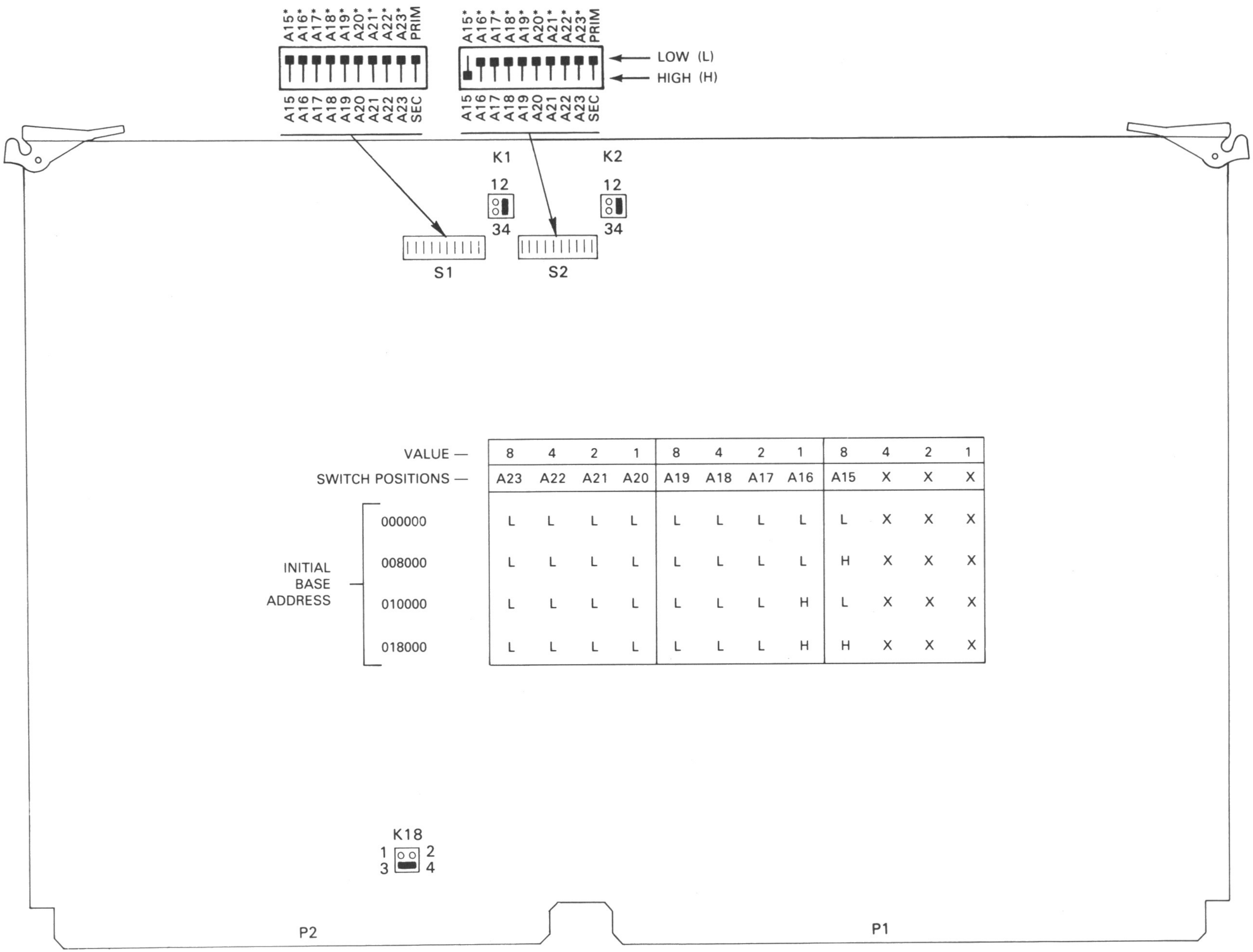
2.3.2 64K Byte Dynamic Memory Module

The 64K Byte Dynamic Memory Module should be inspected/prepared for jumper placements and switch settings prior to system installation. Figure 2-2 illustrates jumper header and switch locations applicable to this memory module. Jumper headers K1 and K2 provide write cycle disabling; K18 provides ROMDIS* signal enabling. Switches S1 and S2 provide base address and map selection for each of the two rows of RAM devices.

2.3.2.1 Write Cycle Disabling (K1 and K2). Jumper headers K1 and K2 allow the user to disable the write cycle operation for a particular memory array (row). This function has no effect on the read cycle operation of the selected memory array.

JUMPER HEADER	PINS CONNECTED	MEMORY ARRAY	REMARKS
K1	1 to 3	1	Write cycle disabled
K2	1 to 3	2	
K1	2 to 4 (1)	1	Write cycle enabled
K2	2 to 4 (1)	2	

NOTE:
(1) Initial factory jumper placement.



	VALUE —	8	4	2	1	8	4	2	1	8	4	2	1
	SWITCH POSITIONS —	A23	A22	A21	A20	A19	A18	A17	A16	A15	X	X	X
INITIAL BASE ADDRESS	000000	L	L	L	L	L	L	L	L	L	X	X	X
	008000	L	L	L	L	L	L	L	L	H	X	X	X
	010000	L	L	L	L	L	L	L	H	L	X	X	X
	018000	L	L	L	L	L	L	L	H	H	X	X	X

FIGURE 2-2. 64K Byte Dynamic Memory Module, Jumper Header and Switch Locations

2.3.2.2 Configured Jumper Headers (K3-K17). Jumper headers K3 through K17 are factory configured and must not be removed or altered. Jumper header configurations are as follows:

JUMPER HEADER	PINS CONNECTED	JUMPER POSITION
K3	2 to 4	Vertical
K4	2 to 4	Vertical
K5	1 to 2	Horizontal
K6	3 to 4	Vertical
K7	3 to 4	Vertical
K8	1 to 2	Horizontal
K9	1 to 3	Vertical
K10	1 to 3	Vertical
K11	1 to 2	Horizontal
K11	3 to 4	Horizontal
K12	1 to 2	Horizontal
K13	1 to 2	Horizontal
K14	None	--
K15	1 to 2	Horizontal
	3 to 4	Horizontal
	5 to 6	Horizontal
	7 to 8	Horizontal
	9 to 10	Horizontal
	11 to 12	Horizontal
	13 to 14	Horizontal
K15	15 to 16	Horizontal
K16	None	--
K17	1 to 2	Horizontal
	3 to 4	Horizontal
	5 to 6	Horizontal
	7 to 8	Horizontal
	9 to 10	Horizontal
	11 to 12	Horizontal
	13 to 14	Horizontal
K17	15 to 16	Horizontal

2.3.2.3 ROMDIS* Signal Enabling (K18). Jumper header K18 allows the user to enable the ROM disable function of the memory module. When the ROM disable function is enabled, the memory module (when addressed) generates a low level ROMDIS* signal. This signal will disable all system ROM at the same memory module address location, thus allowing the memory module to respond to the ROM address.

JUMPER HEADER	PINS CONNECTED	REMARKS
K18	1 to 2	ROMDIS* signal enabled
K18	3 to 4 (1)	ROMDIS* signal disabled

NOTE:

(1) Initial factory jumper placement.

2.3.2.4 Configured Wire Wrap Header (K19). Jumper Header K19 is factory wire wrap jumpered between pins 1 and 4, and must not be removed or altered.

2.3.2.5 Base Address and Map Selection (S1 and S2). The base address and map select switches S1 and S2 allow the user to establish the initial addresses for both memory arrays (rows), and to place the applicable array into the primary or secondary map operation. Both of these switches are Dual In-line Package (DIP) switches which contain ten 2-position slide switches.

When set, the address positions (A15 and A15* through A23 and A23*) enable the applicable array to operate within a 16K continuous address range, beginning at the initial address setting.

When set, the map selection positions (PRIM and SEC) enable the applicable array to operate in either the primary (PRIM) or the secondary (SEC) map.

The initial factory switch settings are as follows:

SWITCH NUMBER	POSITIONS ACTIVATED	ADDRESS RANGE	OPERATING MAP
S1	A15*-A23*, and PRIM	000000-007FFF	Primary
S2	A15, A16*-A23*, and PRIM	008000-00FFFF	Primary

The above switch settings allow the memory module to operate in the primary map, with 32,768 continuous-word (65,536 continuous-byte) addressable locations available.

2.3.3 128K Byte Dynamic Memory Module

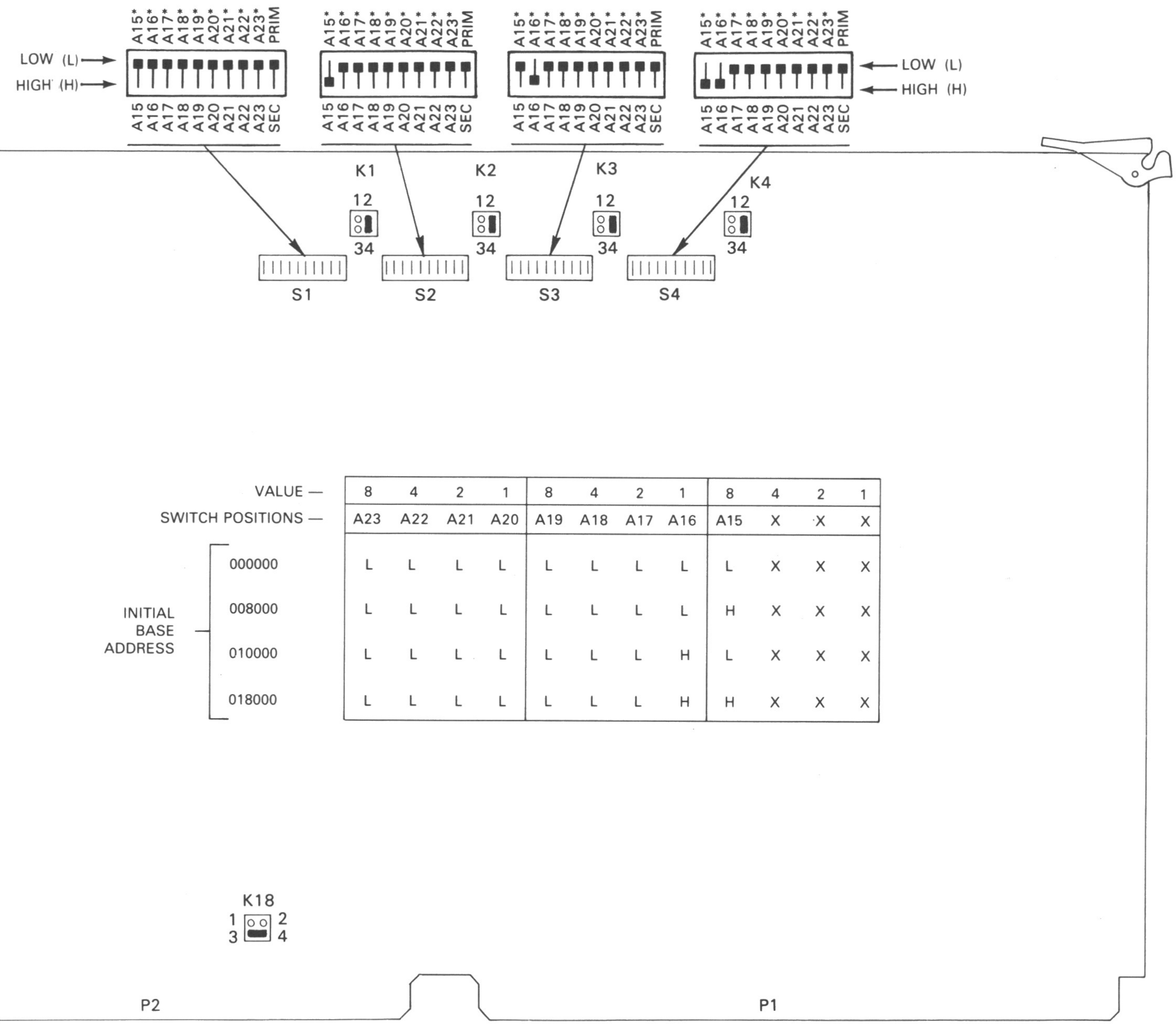
The 128K Byte Dynamic Memory Module should be inspected/prepared for jumper placements and switch settings prior to system installation. Figure 2-3 illustrates jumper header and switch locations applicable to this memory module. Jumper headers K1 through K4 provide write cycle disabling; K18 provides ROMDIS* signal enabling. Switches S1 through S4 provide base address and map selection for each of the four rows of RAM devices.

2.3.3.1 Write Cycle Disabling (K1-K4). Jumper headers K1 through K4 allow the user to disable the write cycle operation for a particular memory array (row). This function has no effect on the read cycle operation of the selected memory array.

JUMPER HEADER	PINS CONNECTED	MEMORY ARRAY	REMARKS
K1	1 to 3	1	Write cycle disabled
K2	1 to 3	2	
K3	1 to 3	3	
K4	1 to 3	4	
K1	2 to 4 (1)	1	Write cycle enabled
K2	2 to 4 (1)	2	
K3	2 to 4 (1)	3	
K4	2 to 4 (1)	4	

NOTE:

(1) Initial factory jumper placement.



VALUE —	8	4	2	1	8	4	2	1	8	4	2	1
SWITCH POSITIONS —	A23	A22	A21	A20	A19	A18	A17	A16	A15	X	X	X
INITIAL BASE ADDRESS 000000	L	L	L	L	L	L	L	L	L	X	X	X
008000	L	L	L	L	L	L	L	L	H	X	X	X
010000	L	L	L	L	L	L	L	H	L	X	X	X
018000	L	L	L	L	L	L	L	H	H	X	X	X

FIGURE 2-3. 128K Byte Dynamic Memory Module, Jumper Header and Switch Locations

2.3.3.2 Configured Jumper Headers (K5-K17). Jumper headers K5 through K17 are factory configured and must not be removed or altered. Jumper header configurations are as follows:

JUMPER HEADER	PINS CONNECTED	JUMPER POSITION
K5	1 to 2	Horizontal
K6	3 to 4	Vertical
K7	3 to 4	Vertical
K8	1 to 2	Horizontal
K9	1 to 3	Vertical
K10	1 to 3	Vertical
K11	1 to 2	Horizontal
K11	3 to 4	Horizontal
K12	1 to 2	Horizontal
K13	1 to 2	Horizontal
K14	None	--
K15	1 to 2	Horizontal
↑	3 to 4	Horizontal
	5 to 6	Horizontal
	7 to 8	Horizontal
	9 to 10	Horizontal
	11 to 12	Horizontal
↓	13 to 14	Horizontal
K15	15 to 16	Horizontal
K16	None	--
K17	1 to 2	Horizontal
↑	3 to 4	Horizontal
	5 to 6	Horizontal
	7 to 8	Horizontal
	9 to 10	Horizontal
	11 to 12	Horizontal
↓	13 to 14	Horizontal
K17	15 to 16	Horizontal

2.3.3.3 ROMDIS* Signal Enabling (K18). Jumper header K18 allows the user to enable the ROM disable function of the memory module. When the ROM disable function is enabled, the memory module (when addressed) generates a low level ROMDIS* signal. This signal will disable all system ROM at the same memory module address location, thus allowing the memory module to respond to the ROM address.

JUMPER HEADER	PINS CONNECTED	REMARKS
K18	1 to 2	ROMDIS* signal enabled
K18	3 to 4 (1)	ROMDIS* signal disabled

NOTE:

(1) Initial factory jumper placement.

2.3.3.4 Configured Wire Wrap Header (K19). Jumper header K19 is factory wire wrap jumpered between pins 1 and 4, and must not be removed or altered.

2.3.3.5 Base Address and Map Selection (S1-S4). The base address and map select switches S1 through S4 allow the user to establish the initial addresses for the four memory arrays (rows), and to place the applicable array into the primary or secondary map operation. All four of these switches are Dual In-line Package (DIP) switches which contain ten 2-position slide switches.

When set, the address positions (A15 and A15* through A23 and A23*) enable the applicable array to operate within a 16K continuous address range, beginning at the initial address setting.

When set, the map selection positions (PRIM and SEC) enable the applicable array to operate in either the primary (PRIM) or the secondary (SEC) map.

The initial factory switch settings are as follows:

SWITCH NUMBER	POSITIONS ACTIVATED	ADDRESS RANGE	OPERATING MAP
S1	A15*-A23*, and PRIM	000000-007FFF	Primary
S2	A15,A16*-A23*, and PRIM	008000-00FFFF	Primary
S3	A15*,A16,A17*-A23*, and PRIM	010000-017FFF	Primary
S4	A15,A16,A17*-A23*, and PRIM	018000-01FFFF	Primary

The above switch settings allow the memory module to operate in the primary map, with 65,536 continuous word (131,072 continuous byte) addressable locations available.

CHAPTER 3

FUNCTIONAL DESCRIPTION

3.1 INTRODUCTION

This chapter provides overall operational and block diagram level descriptions for the 32K, 64K, and 128K Byte Dynamic Memory Modules.

3.2 MEMORY MODULE OPERATIONS

The memory module performs the following operations:

a. Write cycle
b. Read cycle
c. Read-modify-write
d. Input/output enabling
e. Extended addressing
f. RAM/ROM disabling
g. Bus error signal generation

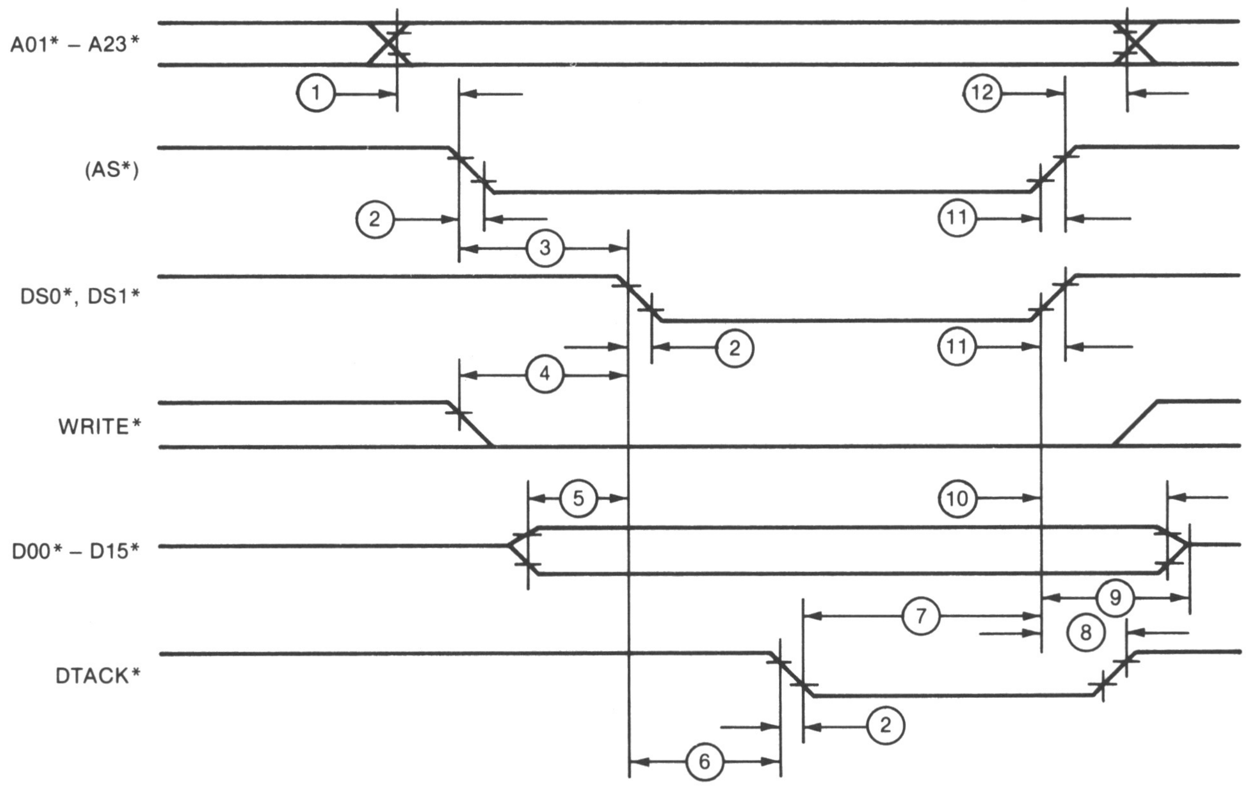
Each memory module operation is described briefly, followed by an associated timing diagram. Within each timing diagram, the VERSAbus Address Strobe (AS*) signal appears in parentheses. This signal does not apply functionally towards the operation of the memory module, but is intended for timing reference purposes only. For additional timing information, refer to the VERSAbus Specification, Motorola publication M68KVBS.

3.2.1 Write Cycle Sequence

The write cycle sequence is performed by the memory module in order to store data into memory. Figure 3-1 illustrates the write cycle timing diagram. The active low level AS* signal indicates that valid and stable addresses are placed on the VERSAbus. WRITE* indicates the direction of data flow on VERSAbus to the memory module. An active low level WRITE* signal indicates a write cycle. Data strobes (DS0* and DS1*) are active low signals that indicate the byte of the data word being stored into memory. These signals also initiate the write cycle sequence.

Data Strobe	Data Bits
DS0*	D00*-D07*
DS1*	D08*-D15*

After the data strobes are active, VERSAbus bus master enters a wait state, which lasts until the memory module stores the data. At this time, the memory module generates a low level DTACK* signal enabling VERSAbus bus master to leave the wait state and continue operations.



NUMBER	PARAMETER
1	Address Setup
2	Fall Time
3	AS* to DS*
4	Write Setup
5	Data Setup
6	DS* to Active DTACK*
7	Strobe Delay
8	DS* to DTACK* Inactive
9	Data Bus Three-Stated
10	Data Hold
11	Rise Time
12	Address Hold

NOTE:

1. Strobe delay parameter is the time required by the VERSAbus bus master to recognize DTACK* and respond by removing DS0*/DS1*.

FIGURE 3-1. Memory Write Cycle Timing Diagram

The memory write cycle sequence is as follows:

a. Memory address is placed on VERSAbus address lines A01*-A23*.

b. Low level WRITE* input signal to memory is activated.

c. Memory data is placed on VERSAbus data lines D00*-D15*.

d. Memory decodes VERSAbus address lines.

e. Low level DS0* and DS1* input signals to memory are activated.

f. Memory latches commands and data, and a low level DTACK* output signal from memory is activated.

g. Memory stores data that has been placed on VERSAbus data lines.

h. Low level DS0* and DS1* input signals to memory are deactivated.

i. Low level DTACK* output signal from memory is deactivated.

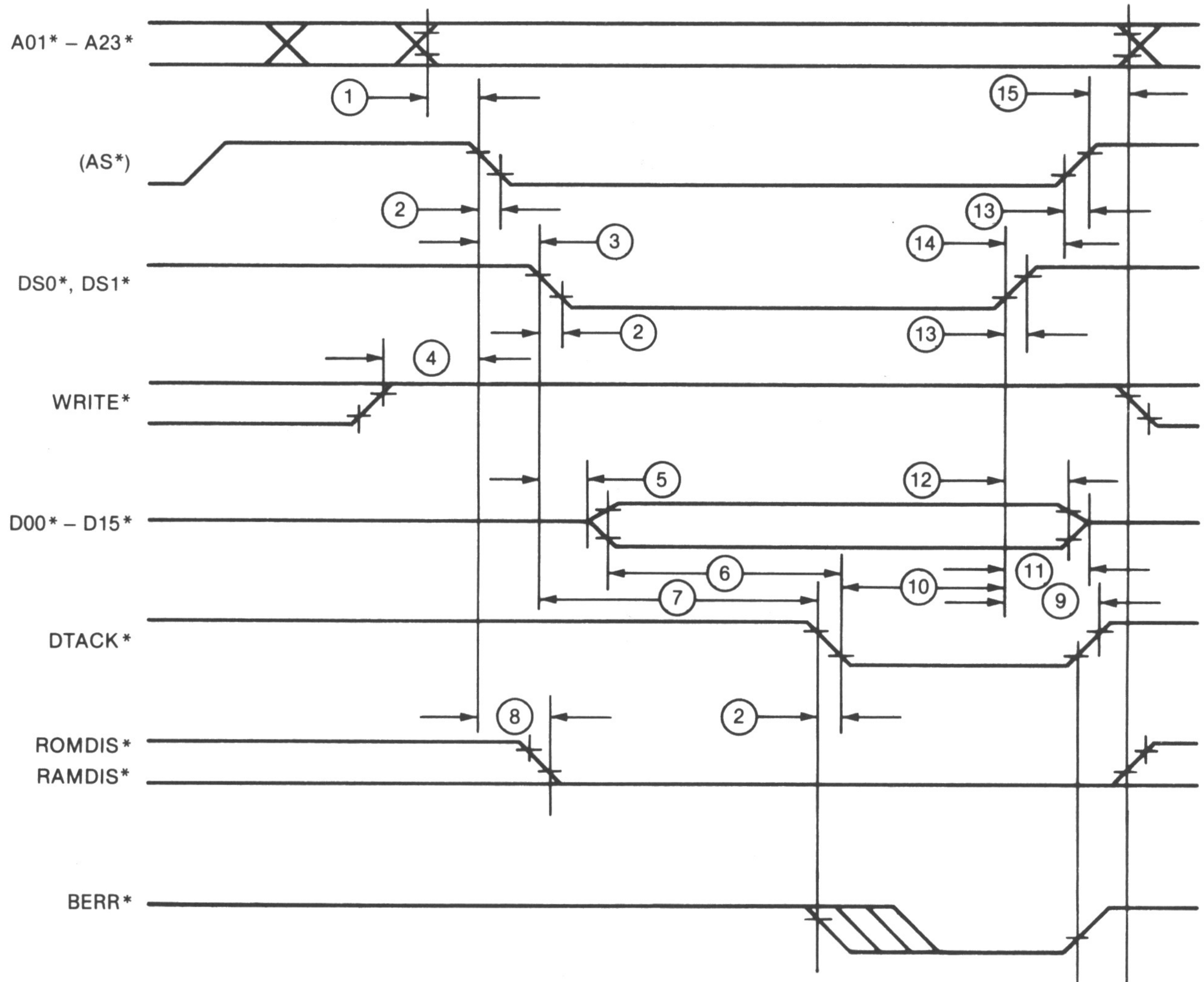
j. Low level WRITE* input signal to memory is deactivated.

3.2.2 Read Cycle Sequence

The read cycle sequence is performed by the memory module in order to retrieve data from memory. Figure 3-2 illustrates the read cycle timing diagram. The active low level AS* signal indicates that valid and stable addresses are placed on VERSAbus. WRITE* indicates the direction of data flow on VERSAbus to the memory module. An inactive high level WRITE* signal indicates a read cycle. Data strobes (DS0* and DS1*) are active low signals that indicate the byte of the data word being retrieved from memory. These signals also initiate the read cycle sequence.

Data Strobe	Data Bits
DS0*	D00*-D07*
DS1*	D08*-D15*

After the data strobes are active, VERSAbus bus master enters a wait state, which lasts until the memory module retrieves the data. At this time, the memory module generates a low level DTACK* signal enabling VERSAbus bus master to leave the wait state and continue operations.



NUMBER	PARAMETER
1	Address Setup
2	Fall Time
3	AS* to DS*
4	Read Setup
5	DS* to Active Data Bus
6	Read Data Setup
7	DS* to Active DTACK*
8	Disable Delay
9	DS* to DTACK* Inactive
10	Strobe Delay
11	Data Bus Three-Stated
12	Data Hold
13	Rise Time
14	Inactive DS* to Inactive AS*
15	Address Hold

NOTES:

1. Strobe delay parameter is the time required by the VERSAbus bus master to recognize DTACK* and respond by removing DS0*/DS1*.
2. When BERR* is activated, DTACK* will be inhibited.

FIGURE 3-2. Memory Read Cycle Timing Diagram

The memory read cycle sequence is as follows:

a. High level WRITE* input signal to memory is activated.

b. Memory address is placed on VERSAbus address lines A01*-A23*.

c. Memory decodes VERSAbus address lines.

d. Low level DS0* and DS1* input signals to memory are activated, and memory latches commands and addresses.

e. Memory retrieves data from memory location and places data on VERSAbus data lines D00*-D15*.

f. Low level DTACK* output signal from memory is activated.

g. Low level DS0* and DS1* input signals to memory are deactivated.

h. Memory removes data from VERSAbus data lines, and the low level DTACK* output signal from memory is deactivated.

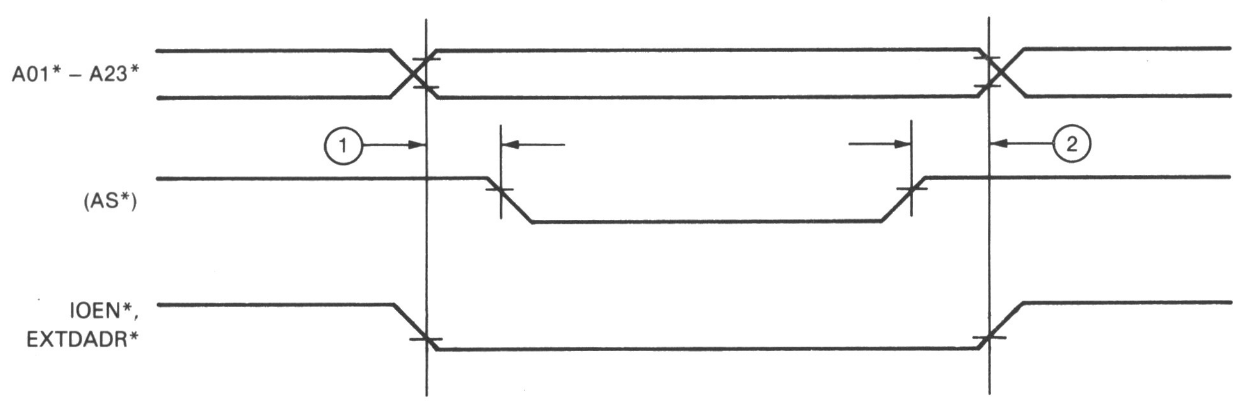
i. High level WRITE* input signal to memory is deactivated.

3.2.3 Read-Modify-Write Cycle Sequence

The read-modify-write cycle sequence consists of a read cycle and a write cycle back to back. For additional information pertaining to this sequence, refer to the VERSAbus Specification.

3.2.4 Input/Output Enabling

The Input Output Enable (IOEN*) signal is used to disable the memory module during system I/O operations. This signal indicates that the lower order address lines (A01*-A23*) contain an address of an I/O device. Figure 3-3 illustrates the timing relationships of this active low level signal.



NUMBER	PARAMETER
1	Address Setup
2	Address Hold

FIGURE 3-3. Memory Input/Output Enabling and Extended Addressing Timing Diagram

3.2.5 Extended Addressing

The Extended Address (EXTDADR*) signal is used for future memory module address expansion purposes. This signal indicates that upper order address lines (A24*-A31*) contain the memory address location beyond the first 16M-byte range. Figure 3-3 also illustrates the timing relationship of this active low level signal.

3.2.6 RAM/ROM Disabling

The Random Access Memory Disable (RAMDIS*) signal is used to disable the memory module. Figure 3-2 illustrates the timing relationship of this active low level signal.

The Read Only Memory Disable (ROMDIS*) signal is generated by the memory module at the beginning of a write or read cycle. Memory module header K18, pins 1 and 2, must be connected for this operation. This signal is used to disable system ROM at the memory locations decoded by the memory module. When system ROM is disabled, the memory module will respond to the ROM address. Figure 3-2 also illustrates the timing relationship of this active low level signal.

Both RAMDIS* and ROMDIS* signals must be activated early in the bus cycle in order to prevent several devices on VERSAbus from enabling data bus drivers and generating DTACK* signal simultaneously.

3.2.7 Bus Error Signal Generation

An active low level Bus Error (BERR*) signal is generated by the memory module when a data parity miscompare occurs. Figure 3-3 illustrates the timing relationship of this active low level signal. BERR* causes termination of the current bus cycle. When BERR* is activated, DTACK* will be inhibited.

3.3 MEMORY MODULE DESCRIPTION

The memory module performs data storage (write mode), retrieval (read mode), and retention (memory refreshing) operations. Odd parity generation/detection capabilities are also performed. The memory module operates on 16-bit data words. Each word consists of two 8-bit bytes. The amount of data words that can be stored or retrieved from memory are as follows:

MEMORY MODULE	NUMBER OF WORDS
32K Byte	16,384 (max.)
64K Byte	32,768 (max.)
128K Byte	65,536 (max.)

Figure 3-4 illustrates the memory module block diagram, which is valid for all three memory modules (32K, 64K, and 128K byte) with only one exception. This exception applies to the size of the memory array, row and address drivers, and select switches which have been described in Chapters 1 and 2. For the remainder of this description, refer to Figure 3-4. The memory module circuits are described functionally for the following operations:

a. Power up and initialization

b. Write mode

c. Read mode

d. Memory refreshing

e. Parity generation/checking

f. Bus error signal generation

g. ROM disable signal generation

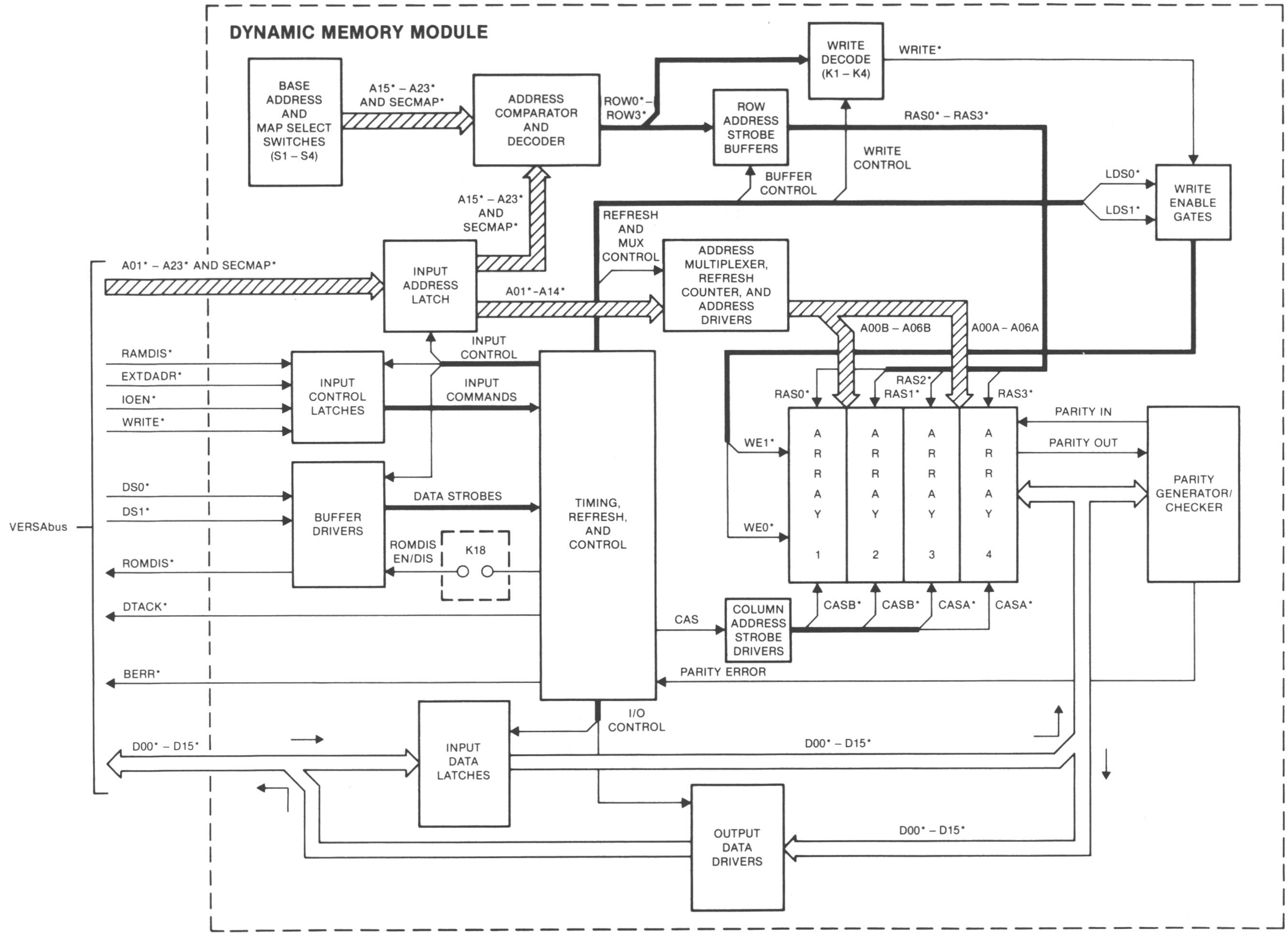


FIGURE 3-4. Memory Module Block Diagram

3.3.1 Power Up and Initialization

When power is applied to the memory module, the refresh oscillator (64KHz) is activated. This initializes the memory module logic circuits and provides an automatic 8-cycle warm-up operation required by the dynamic RAM devices.

In all applications, the memory module must be initialized before performing read operations. This is accomplished by writing (any data pattern) to all memory locations immediately following power up, thereby eliminating parity errors that would occur without initialization. Initialization is normally performed automatically by the system software.

3.3.2 Write Mode of Operation

In the write mode of operation (data storage), least significant address bits A01*-A14* are applied to the address multiplexer via the input address latch. This circuitry multiplexes the 14 address bits to seven address bits, which are applied to the RAM array by way of the address drivers. These seven address bits are used by the RAM array(s) for memory location addressing purposes.

Address bits A15*-A23* and Secondary Map (SECMAP*) signals are applied to the address comparator and decoder circuitry via the input address latch. These signals are compared against the initial (base) address and map select switch settings (S1-S4). If a comparison is made, a Row (ROW) signal is generated and applied to the write decode and row address strobe buffer circuits. Upon receipt of the data strobe signals, the timing and control circuits enable the row address strobe buffers to apply one of the Row Address Strobe (RAS) signals to the memory array. The first seven address bits (A00A-A06A, A00B-A06B) from the address multiplexer are latched into the RAM devices during the high to low transition of the RAS0*-RAS3* signals. A Column Address Strobe (CAS) signal is generated from the control circuitry and applied to the memory array via the column address strobe drivers. During the high to low transition of the CASA* and CASB* signals, the next seven address bits from the multiplexer are latched into the RAM devices. VERSAbus data (D00*-D15*) is stored into the RAM devices via the input data latches.

Figure 3-6 illustrates the memory array and associated control signals. Each array consists of 18 RAM devices. Each RAM device is a 16,384 x 1-bit dynamic RAM integrated circuit chip. Arrays are organized into two sections of memory which are as follows:

SECTION	DATA STORED	CONTROL
Odd Byte	D00-D07 + Parity	WE0*
Even Byte	D08-D15 + Parity	WE1*

As illustrated in Figures 3-4 and 3-5, the sections of a memory array are controlled by the WE0* and WE1* signals via the DS0* (LDS0*) and DS1* (LDS1*) signals, respectively. The WE0* and WE1* signals are generated by the write decode-enable gate circuitry. Jumper headers K1-K4, located in the write decode circuitry, allow the user to disable memory array(s) write cycle operations.

When data is written into memory, the memory module generates a low level DTACK* signal. This signal, along with the data written into memory, completes the write mode of operation.

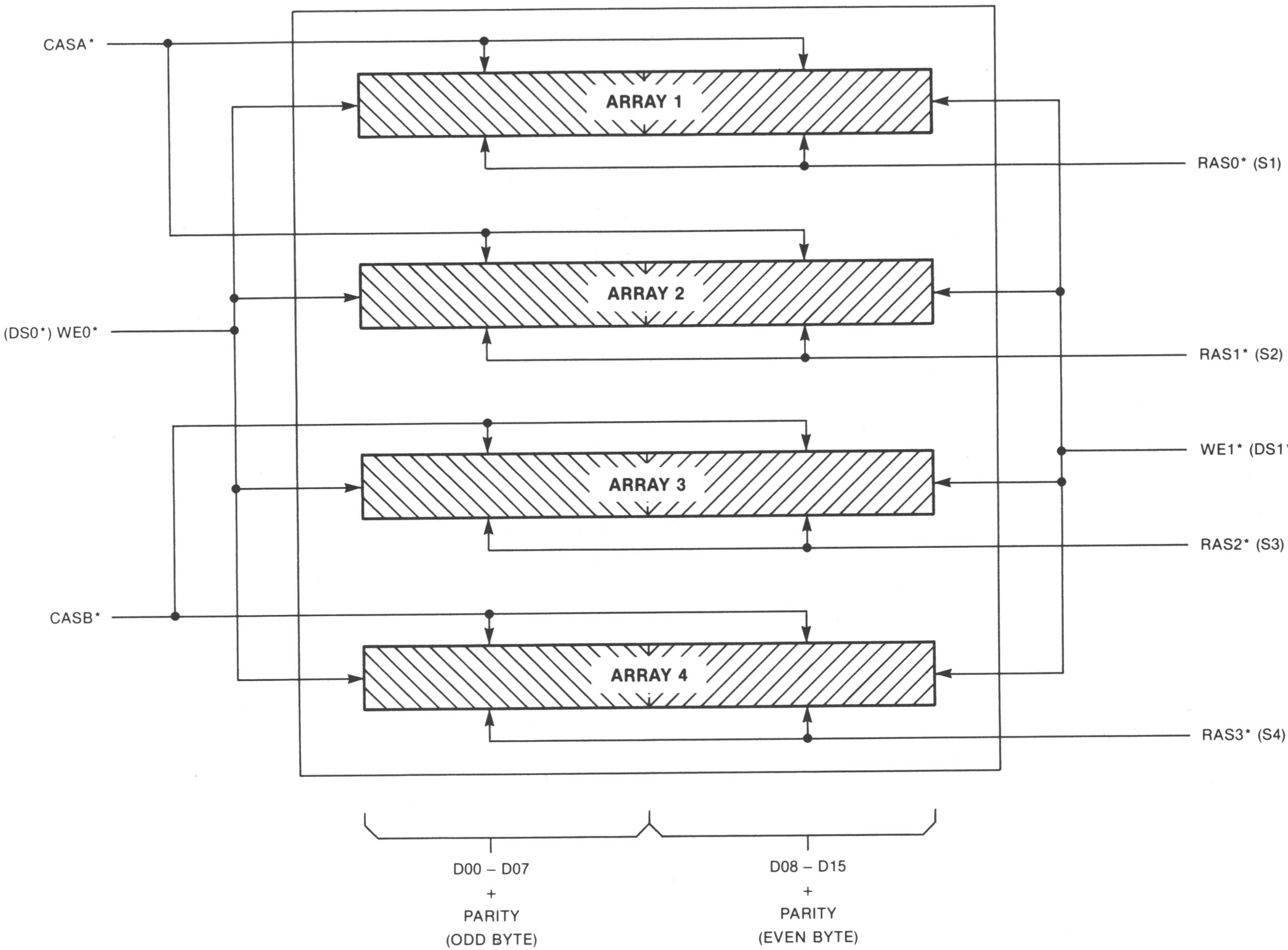


FIGURE 3-5. Memory Array Diagram

3.3.3 Read Mode of Operation

In the read mode of operation (data retrieval), least significant address bits A01*-A14* are applied to the address multiplexer via the input address latch. This circuitry multiplexes the 14 address bits to seven address bits, which are applied to the RAM array by way of the address drivers. These seven address bits are used by the RAM array for memory location addressing purposes.

Address bits A15*-A23* and SECMAP* signals are applied to the address comparator and decoder circuitry via the input address latch. These signals are compared against the initial (base) address and map select switch settings (S1-S4). If a comparison is made, a ROW signal is generated and applied to the write decode and row address strobe buffer circuits. Upon receipt of the data strobe signals, the timing and control circuits enable the row address strobe buffers to apply one of the RAS signals to the memory array. The first seven address bits (A00A-A06A, A00B-A06B) from the address multiplexer are latched into the RAM devices during the high to low transition of the RAS0*-RAS3* signals. A CAS signal is generated from the circuitry and applied to the memory array via the column address strobe drivers. During the high to low transition of the CASA* and CASB* signals, the next seven address bits from the multiplexer are latched into the RAM devices. After the high to low transition of the CASA* and CASB* signals, data (D00*-D15*) is retrieved from the RAM devices and released to the VERSAbus via the output data drivers.

The data buffers (8 bits each) release data onto the VERSAbus according to the corresponding data strobe signals (DS0*/DS1*). When valid data is released on the VERSAbus, the memory module generates a low level DTACK* signal. This signal, along with the valid data, completes the read mode of operation.

If the VERSAbus requires only a byte of data, a complete word is read from the memory array, but only the required byte is released to the VERSAbus. This byte is determined by the data strobe signals.

3.3.4 Memory Refreshing

Memory refreshing (data retention) is performed every 16 microseconds. If there is no normal access in progress (storing or retrieving), memory refreshing will take place. If the memory module is performing an access, the refresh will occur immediately after completion of the access cycle. If an access is attempted during a refresh cycle, the memory module will complete the refresh cycle and then respond to the access request. This is accomplished because the address signals remain valid until the memory module responds with the DTACK* signal.

Refreshing is accomplished by strobing all array RAM devices with A00A-A06A, A00B-A06B, and RAS0*-RAS3* signals. The 7-bit refresh counter generates 128 sequential addresses (A00A-A06A, A00B-A06B) required for refreshing operations. Strobing each of the 128 row addresses of a RAM device with Row Address Strobe (RAS) signals causes all bits stored in each row to be refreshed. The Column Address Strobe (CAS) signals remain at a high level (inactive state) for this operation.

3.3.5 Parity Generation/Checking

The parity generator/checker circuitry generates parity for each 8-bit data byte being stored in memory, and checks parity for each 8-bit data byte being retrieved from memory. When data is stored into memory (via input data latches), parity is calculated (odd) and stored at the same address location with the applicable data byte. When data is retrieved from memory (via output data drivers), parity is re-calculated. This parity value is then compared to the stored parity bit from the same address location. If a miscompare occurs, a PARITY ERROR signal is applied to the control circuitry which enables the generation of the BERR* signal.

3.3.6 Bus Error Signal Generation

Bus Error (BERR*) signal generation occurs when data parity miscompares are detected by the parity generator/checker circuitry. When parity miscompare is detected, a PARITY ERROR signal is applied to the control circuitry. Upon receipt of this signal, the control circuitry will generate a low level BERR* signal to the VERSAbus via jumper header K19. This signal causes termination of the current bus cycle.

3.3.7 ROM Disable Signal Generation

ROM Disable (ROMDIS*) signal generation occurs at the beginning of a write or read cycle. The control circuitry generates a ROMDIS Enable/Disable (EN/DIS) signal via jumper header K18 to the buffer driver circuitry. If a jumper is installed in header K18, the buffer driver circuitry will transfer a low level ROMDIS* signal to the VERSAbus for system ROM disabling purposes.

CHAPTER 4

SUPPORT INFORMATION

4.1 INTRODUCTION

This chapter provides the interconnect signals, parts lists with associated part location diagrams, and schematic diagrams for the 32K, 64K, and 128K Byte Dynamic Memory Modules.

4.2 CONNECTOR SIGNAL DESCRIPTIONS

The memory module is inserted directly into the VERSAbus J1 and J2 backplane sockets. The memory module P1 connector signals are identified in Table 4-1 by pin number, signal mnemonic, and signal name and description. Table 4-2 identifies the P2 connector signals.

TABLE 4-1. Connector P1 Pin Assignments

PIN NUMBER	SIGNAL MNEMONIC	SIGNAL NAME AND DESCRIPTION
1,2, 129-132	+5VDC	+5 Vdc Power - Used by the module logic circuits.
3,4,23,24, 27,28,31,32, 61,62,67,68, 71,72,119, 120,123,124, 135-140	GND	GROUND
5-20	D00*-D15*	DATA bus (bits 0-15) - Sixteen three-state bidirectional data lines that provide a data path between the memory module and all modules connected to VERSAbus.
21,22,30, 33,35,65, 69,70,73-80, 82-94, 107-118,121, 122,133,134	N.C.	NO CONNECTION
25	DS0*	DATA STROBE 0 - An active, low-level input signal which initiates memory write or read cycle operation. Indicates to memory that data transfer is occurring on data lines D00*-D07*, and that all other commands and addresses are stable.

TABLE 4-1. Connector P1 Pin Assignments (cont'd)

PIN NUMBER	SIGNAL MNEMONIC	SIGNAL NAME AND DESCRIPTION
26	DS1*	DATA STROBE 1 - An active, low-level input signal which initiates memory write or read cycle operation. Indicates to memory that data transfer is occurring on data lines D08*-D15*, and that all other commands and addresses are stable.
29	DTACK*	DATA TRANSFER ACKNOWLEDGE - An active, low-level output signal which indicates that data is latched into memory and the write operation has started. This signal also indicates that valid data is available (stable) on VERSAbus during a read operation.
34	WRITE*	WRITE - An active, low-level input signal which defines to memory the type of cycle to be performed (read or write). An active low level signal indicates a write operation, and an inactive high level signal indicates a read operation.
36-58	A01*-A23*	ADDRESS bus (bits 1-23) - Twenty-three three-state input address lines that specify a memory address location.
59	IOEN*	INPUT OUTPUT ENABLE - An active, low-level input signal which disables the memory for system I/O operations. Indicates VERSAbus contains I/O address at present time.
60	EXTDADR*	EXTENDED ADDRESS - An active, low-level input signal which indicates that memory space beyond the first 16M bytes is being addressed. This signal is used for future memory address expansion purposes.
63	SECMAP*	SECONDARY MAP - An active, low-level input signal which indicates/selects the applicable memory array (row) for secondary map operation when active. Indicates/selects the applicable array for primary map operation when inactive (high logic level).
64	ROMDIS*	READ ONLY MEMORY DISABLE - An active, low-level output signal which is generated at the beginning of a write/read cycle and is used to disable system ROM. (Header K18, pins 1 and 2, must be connected for this operation.)
66	RAMDIS*	RANDOM ACCESS MEMORY DISABLE - An active, low-level input which disables memory operations.

TABLE 4-1. Connector P1 Pin Assignments (cont'd)

PIN NUMBER	SIGNAL MNEMONIC	SIGNAL NAME AND DESCRIPTION
81	BERR*	BUS ERROR - An active, low-level output signal which indicates that memory has detected a parity miscompare on the data lines.
95	ACKIN*	ACKNOWLEDGE IN - An active, low-level input signal which is bypassed to the next module on the VERSAbus as ACKOUT*. ACKIN* and ACKOUT* signals are part of the VERSAbus acknowledge daisy-chain.
96	ACKOUT*	ACKNOWLEDGE OUT - An active, low-level output signal which indicates to the next module on the VERSAbus that an acknowledge cycle is in progress.
97,99, 101,103, 105	BG0IN*- BG4IN*	BUS GRANT (0-4) IN - Active, low-level input signals which are bypassed to the next module on the VERSAbus as BG0OUT*-BG4OUT*. Bus grant in and out signals are part of the VERSAbus bus grant daisy-chain.
98,100, 102,104, 106	BG0OUT*- BG4OUT*	BUS GRANT (0-4) OUT - Active, low-level output signals that indicate to the next module on the VERSAbus that it may become the next bus master.
125-128	+12VDC	+12 Vdc Power - Used by the module logic circuits.

TABLE 4-2. Connector P2 Pin Assignments

PIN NUMBER	SIGNAL MNEMONIC	SIGNAL NAME AND DESCRIPTION
1-6,13, 14, 97, 98, 101,102	GND	GROUND
7-10	+5VDC	+5 Vdc Power - Used by the module logic circuits.
11,12	+12VDC	+12 Vdc Power - Used by the module logic circuits.
15,16	-12VDC	-12 Vdc Power - Used by the module logic circuits.
17-96, 103,104	N.C.	NO CONNECTION
99	DS2*	DATA STROBE 2 - An active, low-level input signal which initiates memory write or read cycle operation. Indicates to memory that data transfer is occurring on data lines D16*-D23*, and that all other commands and addresses are stable.
100	DS3*	DATA STROBE 3 - An active, low-level input signal which initiates memory write or read cycle operation. Indicates to memory that data transfer is occurring on data lines D24*-D31*, and that all other commands and addresses are stable.
105-120	D16*-D31*	DATA bus (bits 16-31) - Sixteen three-state bidirectional data lines that provide a path between the memory module and all modules connected to VERSAbus. These data bits are not processed by the memory module at the present time.

4.3 PARTS LISTS

Tables 4-3 through 4-5 list the components of the 32K, 64K, and 128K Byte Dynamic Memory Modules, respectively. The part locations for the 32K, 64K, and 128K Byte Dynamic Memory Modules are illustrated in Figures 4-1 through 4-3, respectively. These parts lists reflect the latest issue of hardware at the time of printing.

TABLE 4-3. 32K Byte Dynamic Memory Module Parts List

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
	84DW6229B01	Printed wiring board, Dynamic RAM Module
	55NW9403A13	Ejector, circuit card, with roll pin attachment, 2 required
C1-C9, C11-C30, C39-C49, C101-C114	21NW9702A09	Capacitor, ceramic, .1 uF @ 50 Vdc
C10,C31-C38, C61,C84-C89, C115-C131, C133-C152, C155-C175, C180	21SW992C025	Capacitor, ceramic, .100 uF @ 50 Vdc
C50-C60, C62-C83, C90-C100	N/A	N/A
C132,C153, C154, C176-C178	23NW9618A33	Capacitor, electrolytic, 22 uF @ 25 Vdc
C179	21NW9702A07	Capacitor, disk, .001 uF @ 1000 Vdc
K1-K13, K18,K19	28NW9802C29 (Issue B only)	Header, double row post, 4-pin
K5,K6	28NW9802C29 (Issue C only)	Header, double row post, 4-pin
K14-K17	28NW9802B34 (Issue B only)	Header, double row post, 16-pin
Q1	51NW9615C39	I.C. MC7905CT
R1-R9, R12-R15	06SW-124A53	Resistor, film, 1.5k ohm, 5%, 1/4 W
R10,R11	06SW-124A70	Resistor, film, 7.5k ohm, 5%, 1/4 W
R16-R18	06SW-124A65	Resistor, film, 4.7k ohm, 5%, 1/4 W
RP1	51NW9626A62	Resistor package, nine 3.3k ohm
S1	40NW9801A37	Switch, toggle, DIP, ten single-pole single-throw, 20-pin
S2-S4	N/A	N/A

TABLE 4-3. 32K Byte Dynamic Memory Module Parts List (cont'd)

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
U1-U18	51NW9615E37	I.C. MCM4116BP-20
U19-U45	N/A	N/A
U46	51NW9615E67	I.C. SN74S260N
U47,U100	51NW9615D32	I.C. SN74S02N
U48,U72,U91, U95,U107	51NW9615C96	I.C. SN74S04N
U49,U78,U89	51NW9615D27	I.C. SN74S32N
U50,U73,U77	51NW9626A68	Resistor network, eight 47 ohm
U51	51NW9615B79	I.C. MC7437P
U52,U99,U136	51NW9615C94	I.C. SN74S00N
U53,U96, U97,U144	51NW9615D92	I.C. SN74S20N
U54-U71	N/A	N/A
U74,U76,U116, U119,U138, U140,U141	51NW9615F65	I.C. SN74S241N
U75	51NW9615E30	I.C. 3242
U79-U87	N/A	N/A
U88,U98	51NW9615C99	I.C. SN74S157N
U90,U105, U134,U137	51NW9615E27	I.C. 74S10PC
U92,U93, U102,U103	51NW9615E35	I.C. DM74S280N
U94,U101	51NW9615C56	I.C. SN74S08N
U104	51NW9615F85	I.C. SN74S38N
U106,U108	51NW9615C95	I.C. SN74S74N
U109,U112, U132,U133, U135	01NW9804B35	100 ns digital delay
U110	51NW9615F31	I.C. DM74S51N

TABLE 4-3. 32K Byte Dynamic Memory Module Parts List (cont'd)

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
U111	51NW9615G56	I.C. SN74S373N
U113	51NW9615D90	I.C. SN74S11N
U115,U117, U118,U139, U142-U145	51NW9615E98	I.C. SN74LS373N
U120,U124, U128,U152	51NW9626A08	Resistor network, thirteen 3.3k ohm
U121-U123	N/A	N/A
U125-U127	N/A	N/A
U129	N/A	N/A
U130,U146, U148	51NW9615C58	I.C. SN74S86N
U131	51NW9615E77	I.C. SN74LS27N
U147	51NW9615D83	I.C. SN74S133N
U149-U151	N/A	N/A
U153	51NW9615B65	I.C. MC1455P1
	09NW9811A04	Socket, I.C., DIL, 16-pin (use at U1-U18)
	09NW9811A33	Socket, I.C., DIL, 8-pin (use at U153)
	29NW9805B13 (Issue B only)	Jumper, two position (use at K1-K13, K15, K17-K19)
	29NW9805B13 (Issue C only)	Jumper, two position (use at K1-K6)
	29NW9805B17 (Issue B only)	Jumper, shorting, insulated (use at K1-K13, K15, K17-K19)
	29NW9805B17 (Issue C only)	Jumper, shorting, insulated (use at K1-K6)

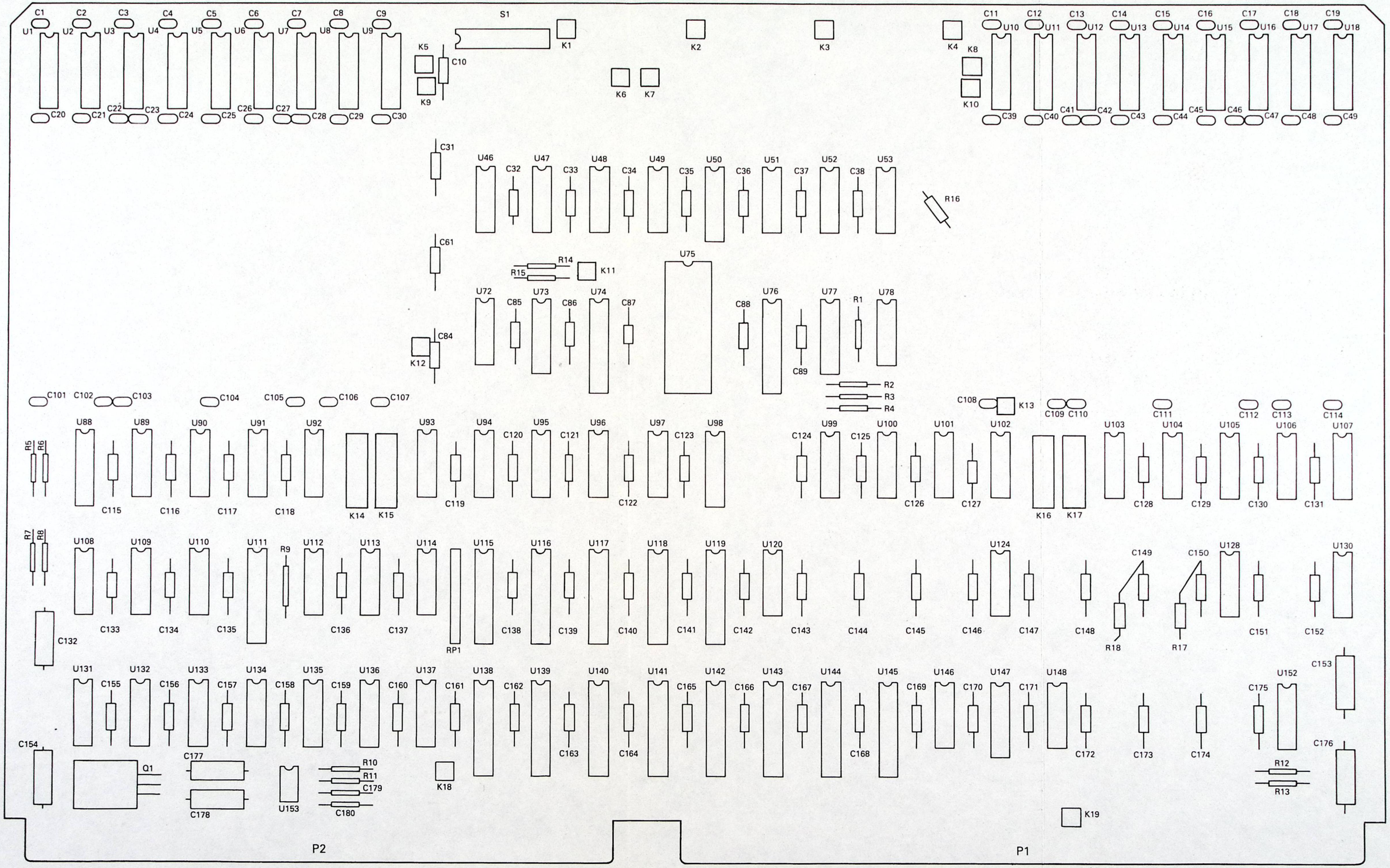


FIGURE 4-1. 32K Byte Dynamic Memory Module, Parts Location Diagram

TABLE 4-4. 64K Byte Dynamic Memory Module Parts List

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
	84DW6229B01	Printed wiring board, Dynamic RAM Module
	55NW9403A13	Ejector, circuit card, with roll pin attachment, 2 required
C1-C9, C11-C30, C39-C60, C62-C72, C101-C114	21NW9702A09	Capacitor, ceramic, .1 uF @ 50 Vdc
C10,C31-C38, C61,C84-C89, C115-C131, C133-C152, C155-C175,C180	21SW992C025	Capacitor, ceramic, .100 uF @ 50 Vdc
C73-C83, C90-C100	N/A	N/A
C132,C153, C154,C176-C178	23NW9618A33	Capacitor, electrolytic, 22 uF @ 25 Vdc
C179	21NW9702A07	Capacitor, disk, .001 uF @ 1000 Vdc
K1-K13, K18,K19	28NW9802C29 (Issue B only)	Header, double row post, 4-pin
K5, K6	28NW9802C29 (Issue C only)	Header, double row post, 4-pin
K14-K17	28NW9802B34 (Issue B only)	Header, double row post, 16-pin
Q1	51NW9615C39	I.C. MC7905CT
R1-R9, R12-R15	06SW-124A53	Resistor, film, 1.5k ohm, 5%, 1/4 W
R10,R11	06SW-124A70	Resistor, film, 7.5k ohm, 5%, 1/4 W
R17,R18	06SW-124A65	Resistor, film, 4.7k ohm, 5%, 1/4 W
RP1	51NW9626A62	Resistor package, nine 3.3k ohm
S1,S2	40NW9801A37	Switch, toggle, DIP, ten single-pole single-throw, 20-pin
S3,S4	N/A	N/A

TABLE 4-4. 64K Byte Dynamic Memory Module Parts List (cont'd)

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
U1-U36	51NW9615E37	I.C. MCM4116BP-20
U37-U45	N/A	N/A
U46	51NW9615E67	I.C. SN74S260N
U47,U100	51NW9615D32	I.C. SN74S02N
U48,U72,U91, U95,U107	51NW9615C96	I.C. SN74S04N
U49,U78,U89	51NW9615D27	I.C. SN74S32N
U50,U73,U77	51NW9626A68	Resistor network, eight 47 ohm
U51	51NW9615B79	I.C. MC7437P
U52,U99,U136	51NW9615C94	I.C. SN74S00N
U53,U96, U97,U114	51NW9615D92	I.C. SN74S20N
U54-U71	N/A	N/A
U74,U76, U116,U119, U138,U140,U141	51NW9615F65	I.C. SN74S241N
U75	51NW9615E30	I.C. 3242
U79-U87	N/A	N/A
U88,U98	51NW9615C99	I.C. SN74S157N
U90,U105, U134,U137	51NW9615E27	I.C. 74S10PC
U92,U93, U102,U103	51NW9615E35	I.C. DM74S280N
U94,U101	51NW9615C56	I.C. SN74S08N
U104	51NW9615F85	I.C. SN74S38N
U106,U108	51NW9615C95	I.C. SN74S74N
U109,U112, U132,U133,U135	01NW9804B35	100 ns digital delay
U110	51NW9615F31	I.C. DM74S51N

TABLE 4-4. 64K Byte Dynamic Memory Module Parts List (cont'd)

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
U111	51NW9615G56	I.C. SN74S373N
U113	51NW9615D90	I.C. SN74S11N
U115,U117, U118,U139, U142-U145	51NW9615E98	I.C. SN74LS373N
U120,U124, U128,U152	51NW9626A08	Resistor network, thirteen 3.3k ohm
U121,U123, U129,U130, U146,U148	51NW9615C58	I.C. SN74S86N
U122,U147	51NW9615D83	I.C. SN74S133N
U125-U127	N/A	N/A
U131	51NW9615E77	I.C. SN74LS27N
U149-U151	N/A	N/A
U153	51NW9615B65	I.C. MC1455P1
	09NW9811A04	Socket, I.C., DIL, 16-pin (use at U1-U36)
	09NW9811A33	Socket, I.C., DIL, 8-pin (use at U153)
	29NW9805B13 (Issue B only)	Jumper, two position (use at K1-K13, K15, K17-K19)
	29NW9805B13 (Issue C only)	Jumper, two position (use at K1-K6)
	29NW9805B17 (Issue B only)	Jumper, shorting, insulated (use at K1-K13, K15, K17-K19)
	29NW9805B17 (Issue C only)	Jumper, shorting, insulated (use at K1-K6)

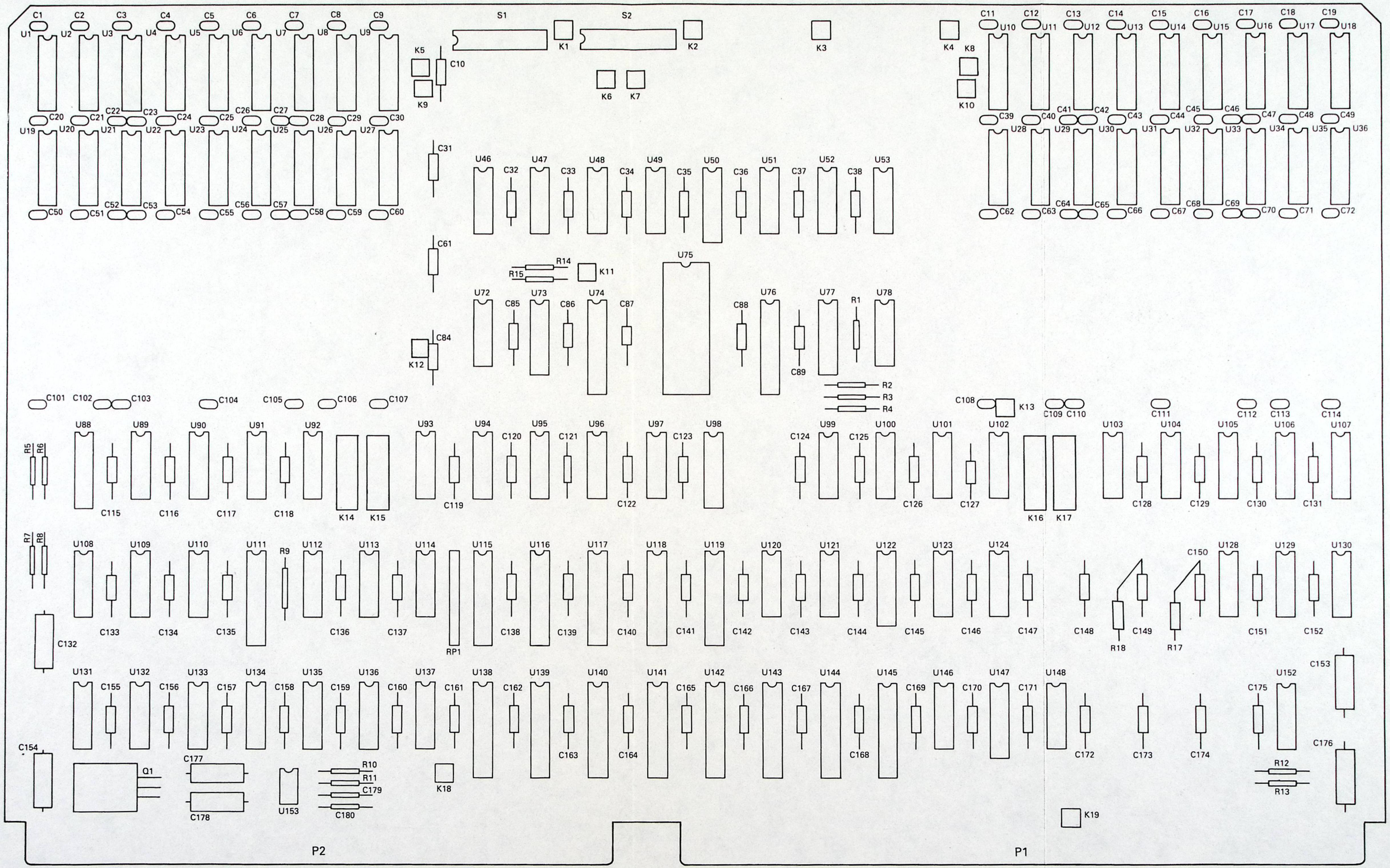


FIGURE 4-2. 64K Byte Dynamic Memory Module, Parts Location Diagram

TABLE 4-5. 128K Byte Dynamic Memory Module Parts List

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
	84DW6229B01	Printed wiring board, Dynamic RAM Module
	55NW9403A13	Ejector, circuit card, with roll pin attachment, 2 required
C1-C9, C11-C30, C39-C60, C62-C83, C90-C114	21NW9702A09	Capacitor, ceramic, .1 uF @ 50 Vdc
C10,C31-C38, C61,C84-C89, C115-C131, C133-C152, C155-C175, C180	21SW992C025	Capacitor, ceramic, .001 uF @ 50 Vdc
C132,C153, C154,C176-C178	23NW9618A33	Capacitor, electrolytic, 22 uF @ 25 Vdc
C179	21NW9702A07	Capacitor, disk, .001 uF @ 1000 Vdc
K1-K13, K18,K19	28NW9802C29 (Issue B only)	Header, double row post, 4-pin
K5,K6	28NW9802C29 (Issue C only)	Header, double row post, 4-pin
K14-K17	28NW9802B34 (Issue B only)	Header, double row post, 16-pin
Q1	51NW9615C39	I.C. MC7905CT
R1-R9, R12-R15	06SW-124A53	Resistor, film, 1.5k ohm, 5%, 1/4 W
R10,R11	06SW-124A70	Resistor, film, 7.5k ohm, 5%, 1/4 W
RP1	51NW9626A62	Resistor package, 10-pin, nine 3.3k ohm
S1-S4	40NW9801A37	Switch, toggle, DIP, ten single-pole single-throw, 20-pin
U1-U45, U54-U71, U79-U87	51NW9615E37	I.C. MCM4116BP-20
U46	51NW9615E67	I.C. SN74S260N
U47,U100	51NW9615D32	I.C. SN74S02N

TABLE 4-5. 128K Byte Dynamic Memory Module Parts List (cont'd)

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
U48,U72,U91, U95,U107	51NW9615C96	I.C. SN74S04N
U49,U78,U89	51NW9615D27	I.C. SN74S32N
U50,U73,U77	51NW9626A68	Resistor network, eight 47 ohm
U51	51NW9615B79	I.C. MC7437P
U52,U99,U136	51NW9615C94	I.C. SN74S00N
U53,U96, U97,U114	51NW9615D92	I.C. SN74S20N
U74,U76, U116,U119, U138,U140,U141	51NW9615F65	I.C. SN74S241N
U75	51NW9615E30	I.C. 3242
U88,U98	51NW9615C99	I.C. SN74S157N
U90,U105, U134,U137	51NW9615E27	I.C. 74S10PC
U92,U93, U102,U103	51NW9615E35	I.C. DM74S280N
U94,U101	51NW9615C56	I.C. SN74S08N
U104	51NW9615F85	I.C. SN74S38N
U106,U108	51NW9615C95	I.C. SN74S74N
U109,U112, U132,U133,U135	01NW9804B35	100 ns digital delay
U110	51NW9615F31	I.C. DM74S51N
U111	51NW9615G56	I.C. SN74S373N
U113	51NW9615D90	I.C. SN74S11N
U115,U117, U118,U139, U142-U145	51NW9615E98	I.C. SN74LS373N
U120,U124, U128,U152	51NW9626A08	Resistor network, thirteen 3.3k ohm

TABLE 4-5. 128K Byte Dynamic Memory Module Parts List (cont'd)

REFERENCE DESIGNATION	MOTOROLA PART NUMBER	DESCRIPTION
U121,U123, U125,U127, U129,U130, U146,U148, U149,U151	51NW9615C58	I.C. SN74S86N
U122,U126, U147,U150	51NW9615D83	I.C. SN74S133N
U131	51NW9615E77	I.C. SN74LS27N
U153	51NW9615B65	I.C. MC1455P1
	09NW9811A04	Socket, I.C., DIL, 16-pin (use at U1-U45, U54-U71, U79-U87)
	09NW9811A33	Socket, I.C., DIL, 8-pin (use at U153)
	29NW9805B13 (Issue B only)	Jumper, two position (use at K1-K13, K15, K17-K19)
	29NW9805B13 (Issue C only)	Jumper, two position (use at K1-K6)
	29NW9805B17 (Issue B only)	Jumper, shorting, insulated (use at K1-K13, K15, K17-K19)
	29NW9805B17 (Issue C only)	Jumper, shorting, insulated (use at K1-K6)

4.4 DIAGRAMS

Figure 4-4 illustrates the schematic diagram for the 128K Byte Dynamic Memory Module. This diagram is valid for the depopulated memory modules (32K and 64K).

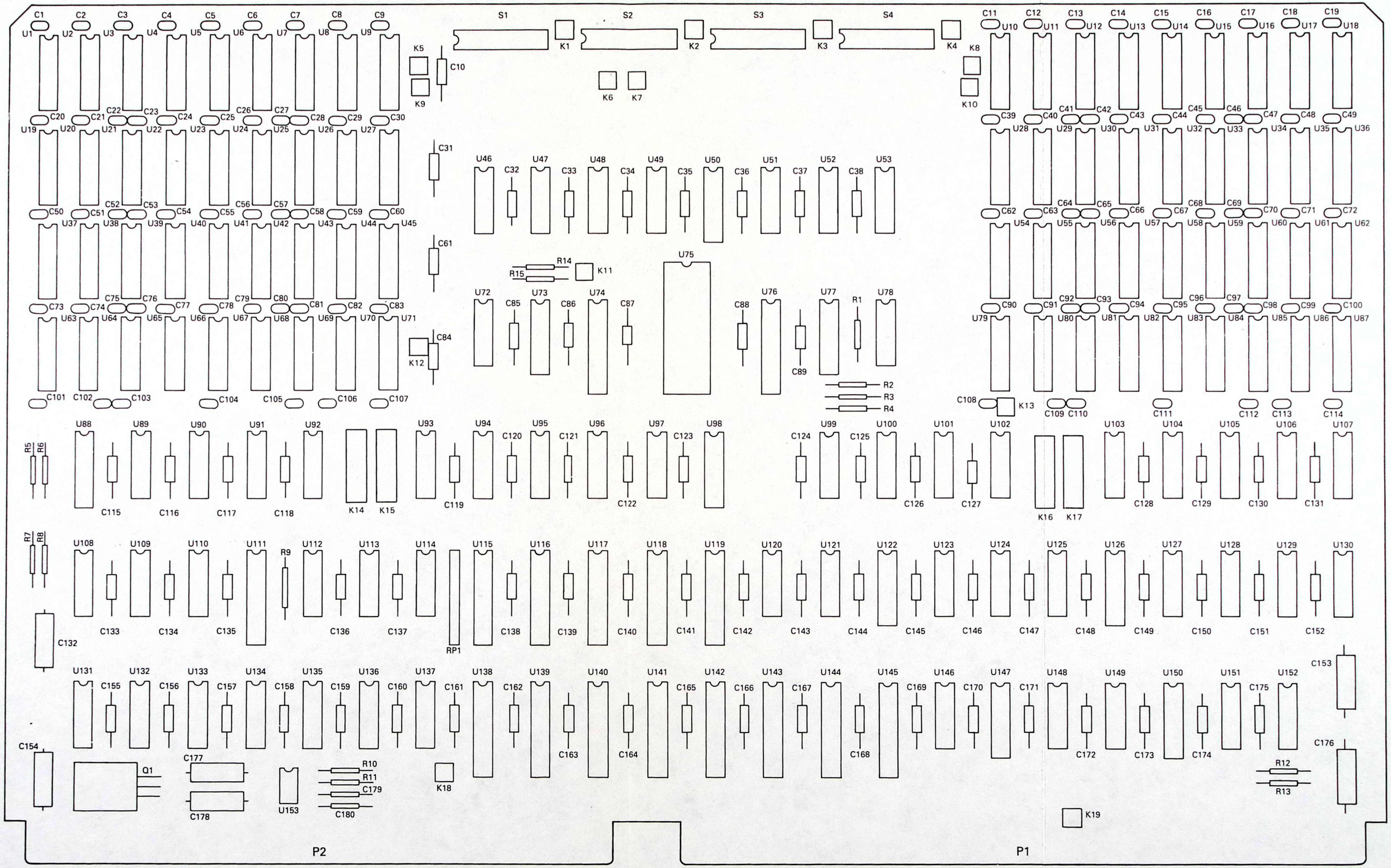
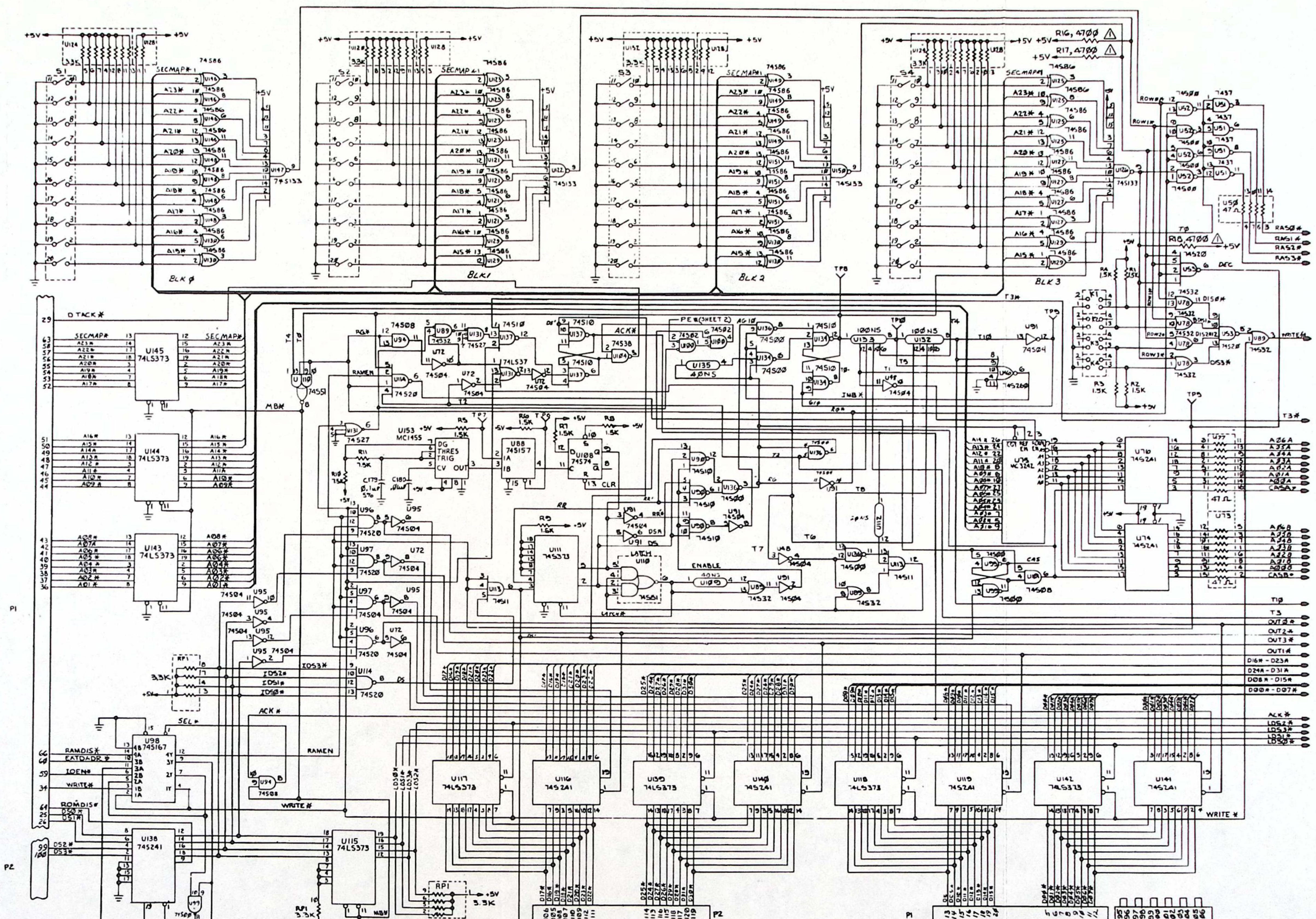


FIGURE 4-3. 128K Byte Dynamic Memory Module, Parts Location Diagram



NOTE. U-111 MUST BE SCHOTTKY (74S373)

RESISTOR OPTION TABLE ⚠				
MEMORY FUNCTION	PART NUMBER	WHEN AND WHEN NOT TO INSERT RESISTOR REFERENCE DESIGNATION		
N/A	N A	R16	R17	R18
128K	Ø1-W1229BØ1	OUT	OUT	OUT
64K	Ø1-W1229BØ2	OUT	IN	IN
32K	Ø1-W1229BØ3	IN	IN	IN

UNUSED GATES

TYPE	U#	INPUT PIN#	OUTPUT PIN#
74S74	1Ø8	2,3	5,6
SØØ	99	1, 2	3
SØ4	1Ø7	3,9,11	4,8,1Ø
S1Ø	1Ø5	3,4,5,9,1Ø,11	6,8
SØ2	1ØØ	2,3,5,6,11,12	1,4,13
SØ2	1ØØ	8,9	1Ø
S3Ø	1Ø4	11,12	13

REV STATUS	REV	G	G
OF SHEETS	SH	1	2

FIGURE 4-4. 128K Byte Dynamic Memory Module Schematic Diagram (Sheet 1 of 2)

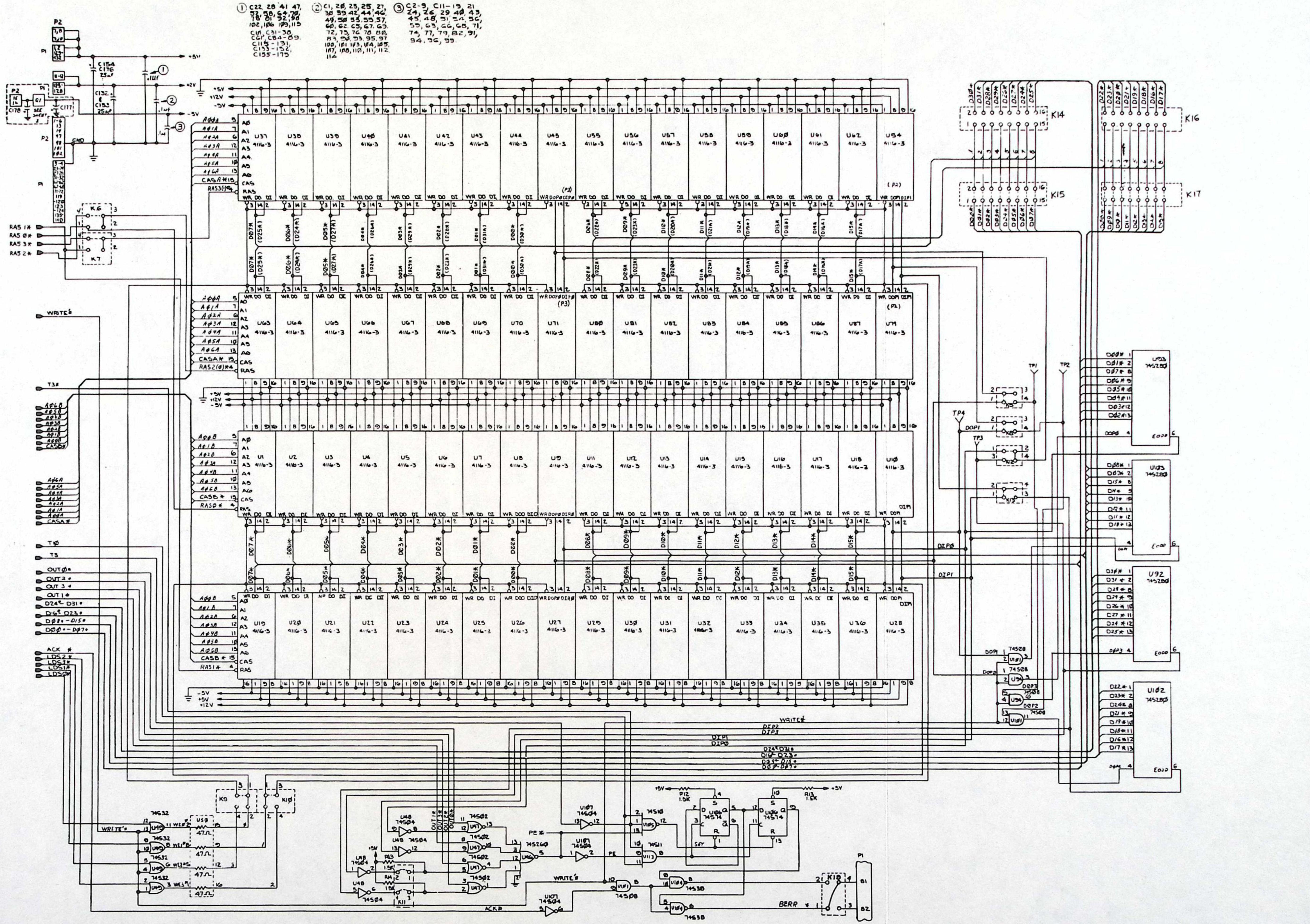


FIGURE 4-4. 128K Byte Dynamic Memory Module Schematic Diagram (Sheet 2 of 2)

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SPECIFICATIONS

Input Voltage: 115VAC±10% 47-63Hz.
230VAC±10% 47-63Hz.

Output Voltage: Voltages and load current ratings are given in the following table:

TABLE 1.

Model MM22

Output Voltage	Rated Load Current (AMPS) V1	V2	V3	V4	V5
2		12			
5	75	12			
12		10			
15		10			
18		8			
24		5			
28		5			

MMX22

2		18			
5	75	18			
12		16			
15		16			
18		12			
24		10			
28		10			

MM23

2		10	10		
5	75	10	10		
12		8	8		
15		8	8		
18		6	6		
24		5	5		
28		5	5		

MM24

2		12	5	5	
5	75	10	5	5	
12		8	3	3	
15		8	3	3	
18		6	2	2	
24		5	2	2	
28		4	2	2	

TABLE 1. continued

MM25

Output Voltage	Rated Load Current (Amps				
	V1	V2	V3	V4	V5
2		5	5	5	5
5	75	5	5	5	5
12		3	3	3	3
15		3	3	3	3
18		3	3	3	3
24		2	2	2	2
28		2	2	2	2

NOTE: A minimum load of 7.5A is required on the main 5V output to maintain voltage on auxiliary outputs. Maximum output from any combination of main and auxiliary outputs must not exceed 375 watts.

Line Regulation: 0.4% over entire input range.

Load Regulation: 0.4% for no load to full load.

Interaction: 0.1% maximum (static).

Ripple and Noise: 1% P-P or 50mV, whichever is greater.

Overvoltage Protection: Standard for main outputs. Optional on auxiliary outputs. Factory set at 125±5%.

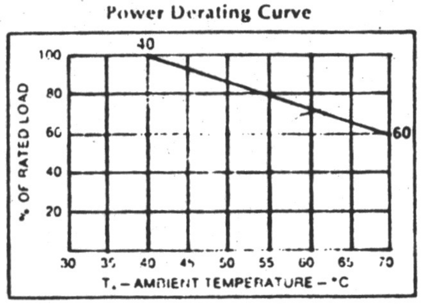
Overshoots and Undershoots: 2% peak deviation for a 25% load change at 5A/µs.

Response Time: 200µs to 1% after a 25% load change at 5A/µs.

Holdup Time: Outputs remain in regulation for a minimum of 20MS after loss of nominal AC power.

Operating Temperature: $0^{\circ}C$ to $70^{\circ}C$ (see derating curve).

Power Derating Curve



Efficiency: Up to 80%, typically 70%.

Output Polarity: Outputs are independent and floating and may be referenced as desired. The output may be floated up to 100V off chassis ground.

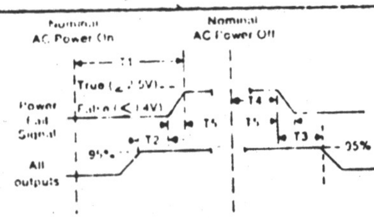
Input Connections: AC input is provided through a heavy duty non-breakable terminal block.

Output Connections: Main output with rating up to 375 watts have nickle plated 1/4 x 20 studs. Auxiliary outputs are through a heavy duty non-breakable terminal block.

Output Adjustments: All outputs have voltage adjustment potentiometers accessible from the front panel. Current limit and OVP adjustments are factory set.

Power Fail Detection: Upon AC removal, power fail signal will drop to zero at least 2MS before loss of DC output. This signal is referenced to the (-) output stud.

Power On/Off Sequence:



T1 < 1.0 second
T2 > 10 milliseconds
T3 > 2 milliseconds
T4 > 20 milliseconds (T4 > 0 millisecond when remote on/off is used)
T5 < 1 microsecond
Power fail (0) sink current 2 ma maximum
Power fail (1) source current 400 μA maximum

Remote On/Off: Power supply is turned on with open circuit or with TTL Logic "1" and is turned off with TTL Logic "0" (800 Mv maximum) sinking 400μA referenced to (V1) negative sense terminal.

Current Limit: All outputs have foldback current limit with automatic recovery after overload is removed.

Temperature Coefficient: +0.2%/^{0}C.

Storage Temperature: -55^{0}C to +85^{0}C.

Other Features: Remote sense on the main outputs. Compensation for up to 250mV load cable loss can be accommodated. Remote sense is also provided on 2nd and 3rd outputs of two and three output supplies.

Internal thermal switch. Will turn off the power supply in case of overheating.

Input RFI line filter. Independent LC section on each side of the AC line.

Reverse voltage protection. All outputs have reverse voltage protection up to 100% of rated current on main outputs. 3 amps average on all other outputs.

Limited inrush current. AC input inrush current is 42 amps RMS when averaged over one cycle.

Automatic internal sensing. Internal sensing is automatic through resistors if sense lines are opened.

Straight paralleling. The main output can be straight paralled to provide additional current ratings.

INTRODUCTION

The LHR Switching Power Supply Series MM20, is specifically designed for computer and terminal application. The light weight power supply provides two, three, four or five outputs, the combined wattage of all outputs must not exceed 375W. A minimum load of 7.5A is required on the main output to maintain regulation on the auxiliary outputs.

THEORY OF OPERATION

1. General Description (See Figure 1)

Each main output of the LHR Switching Power Supply is a pulse-width modulated chopper converter.

The AC input is rectified, doubled and filtered to 300VDC in the 115VAC input power supply. The AC input is rectified and filtered to 300VDC in the 230VAC input power supply. The 300VDC is then chopped and transformed to a lower voltage using a half-bridge-converter.

The transformer secondary output (consisting of a quasi-square wave) is rectified and filtered to the final DC output value.

The output is sensed and the error signal voltage is amplified and used to control the pulse width of the chopper, thus regulating the output voltage within narrow limits under all conditions of the input line and the output load.

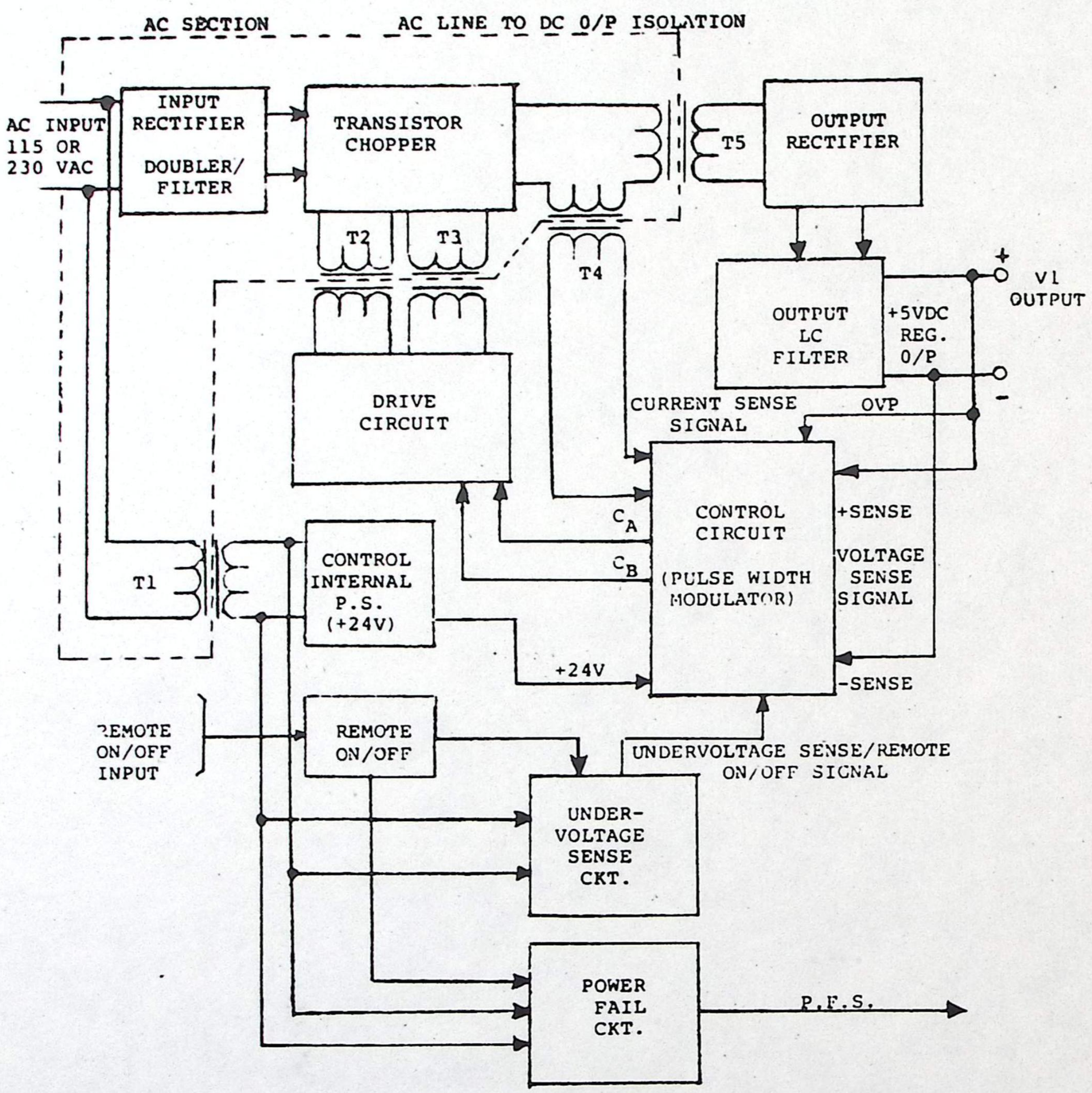
The output and all control circuitry are isolated from AC input line.

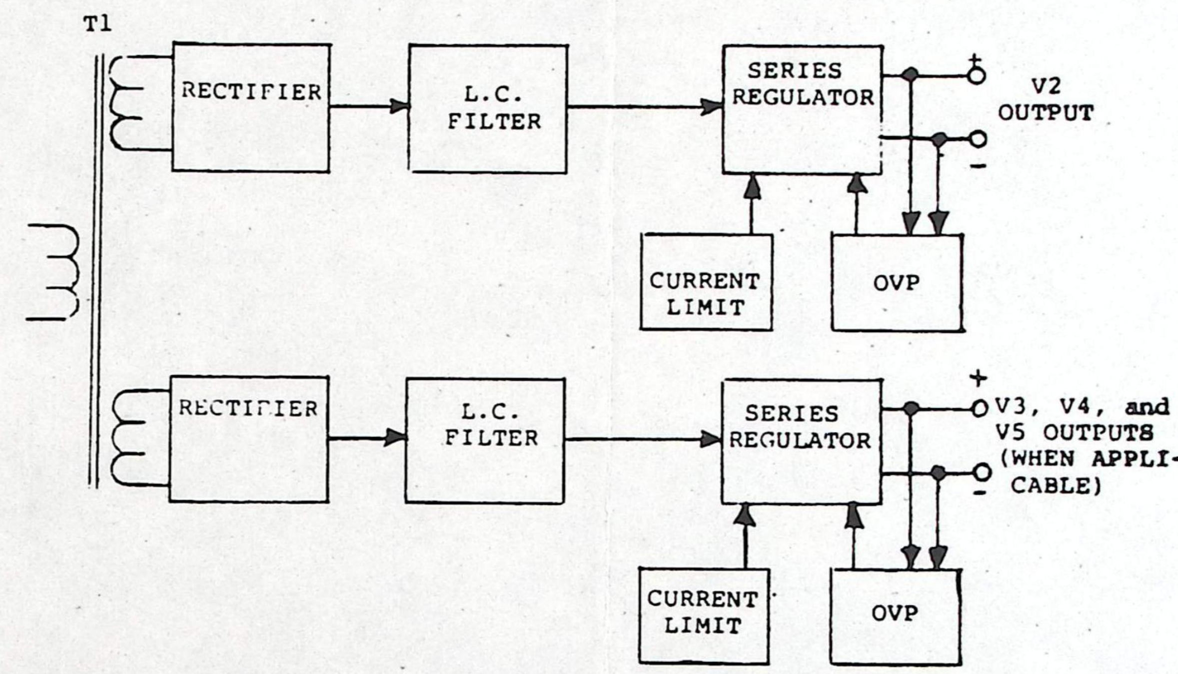
This power supply has input undervoltage sense, soft start control, output current limiting and output overvoltage protection.

2. Detailed Description (See Schematic)

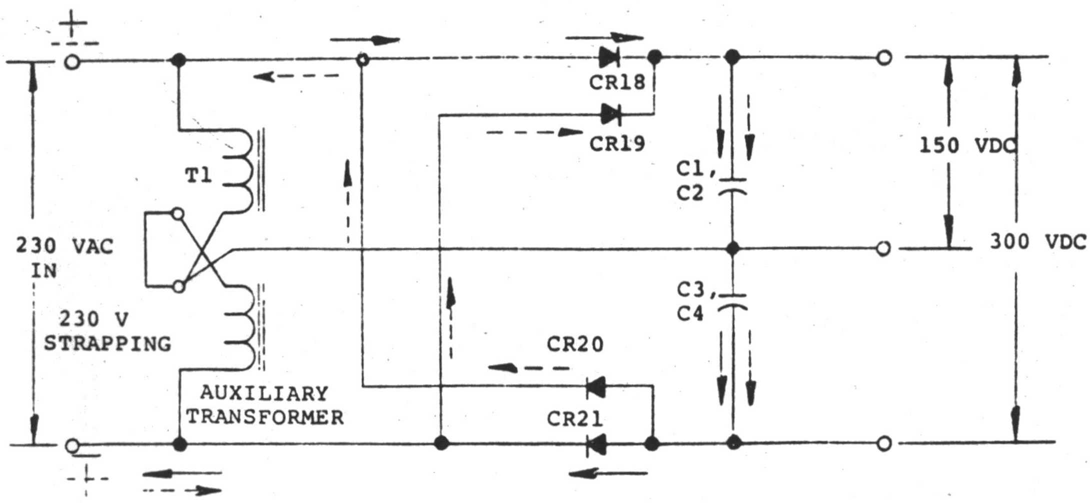
A. Input Filter.
The input filter consists of L1, C1 and C2 that form an RF noise suppression filter. R1 and R2 are thermistors with a high resistance at low temperature. The thermistors limit the input start-up current. The filter operation, including polarity and current flow is described by Figures 2 and 3. R1 and R2 are the bleeder resistors. The strapping connections at T1 allow the use of the same assembly for 115 or 230VAC input.

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
NC	PRODUCTION RELEASED		

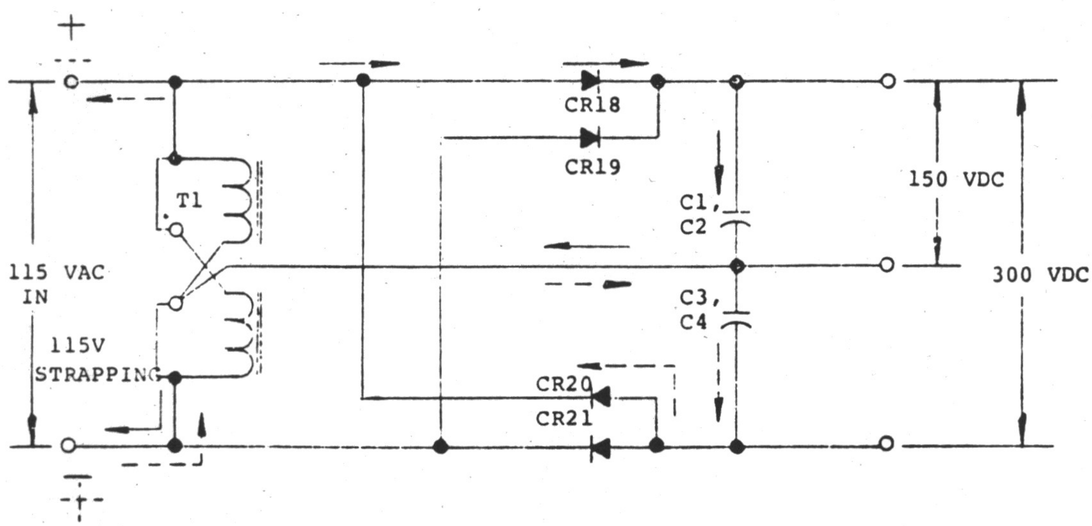




DRAFTSMAN	DATE	LH RESEARCH	
CHECKER		BLOCK DIAGRAM FIGURE 1.	
APPR.			
NEXT ASS'Y	USED ON	DWG SIZE B	DWG NO. 46360	REV. A
APPLICATION		TOLERANCE .XX .XXX ANGLE UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES	SCALE



Simplified Input Rectifier/Filter Section
(230VAC Input Strapping)
Figure 2



Simplified Input Rectifier/Filter/Doubler Section
(115VAC Input Strapping)
Figure 3

B. Chopper Section. (See Figures 4 and 5)
Transistors Q1 and Q4 are alternately turned on and off at a 20KHz rate. C10 is a balance capacitor and T4 is a current sensing transformer. R19 and C11 form a primary RC snubber to attenuate voltage overshoots. CR7 and CR8 prevent reverse conduction of Q1 and Q4 during transient conditions. The switching action of Q1 and Q4 applies a quasi-square voltage waveform of 300 volts peak to peak to primary of T5.

C. Output Rectifier and Filters.
Quasi-square voltage waveform is transformed down by T5 on the control board. The output is rectified by CR16 and CR17 and filtered by L2. R25 and C13 form a secondary snubber network. The output is filtered by an LC filter, on the buss bar assembly, consisting of L1, L2 and C1, C2. Ripple and RFI is further reduced by C1, C2, C3 and C4 located on the RFI filter board.

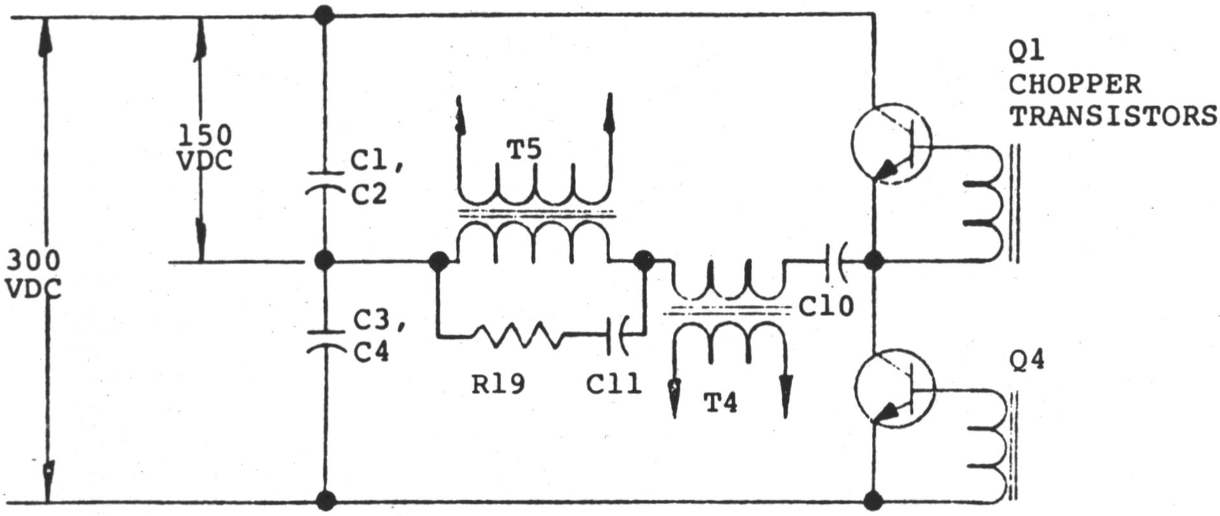
D. Internal Auxiliary Power Supply.
T1 transforms 115 or 230VAC line voltage to supply +24VDC unregulated to the control circuit. CR1, CR2, CR3 and CR4 form a full bridge rectifier and C3 filters the output.

TS1 is a thermal switch in contact with the output rectifier (CR16 and CR17) heat sink. TS1 opens if overheating occurs and removes drive to Q1 and Q4 by turning off control circuitry.

E. Control Circuitry. (See Table 2)
The control module #1 (45123) contains a pulse-width-modulator, IC SG3524, and provides all the basic control functions as follows:

1) Voltage Amplifier and Reference
2) Overvoltage Protection
3) Undervoltage Protection
4) Soft Start
5) Remote On-Off
6) Power Fail
7) Current Limit

The adjustments on the control module #1 (45123) are factory set, and it should not normally be necessary to readjust the factory settings.



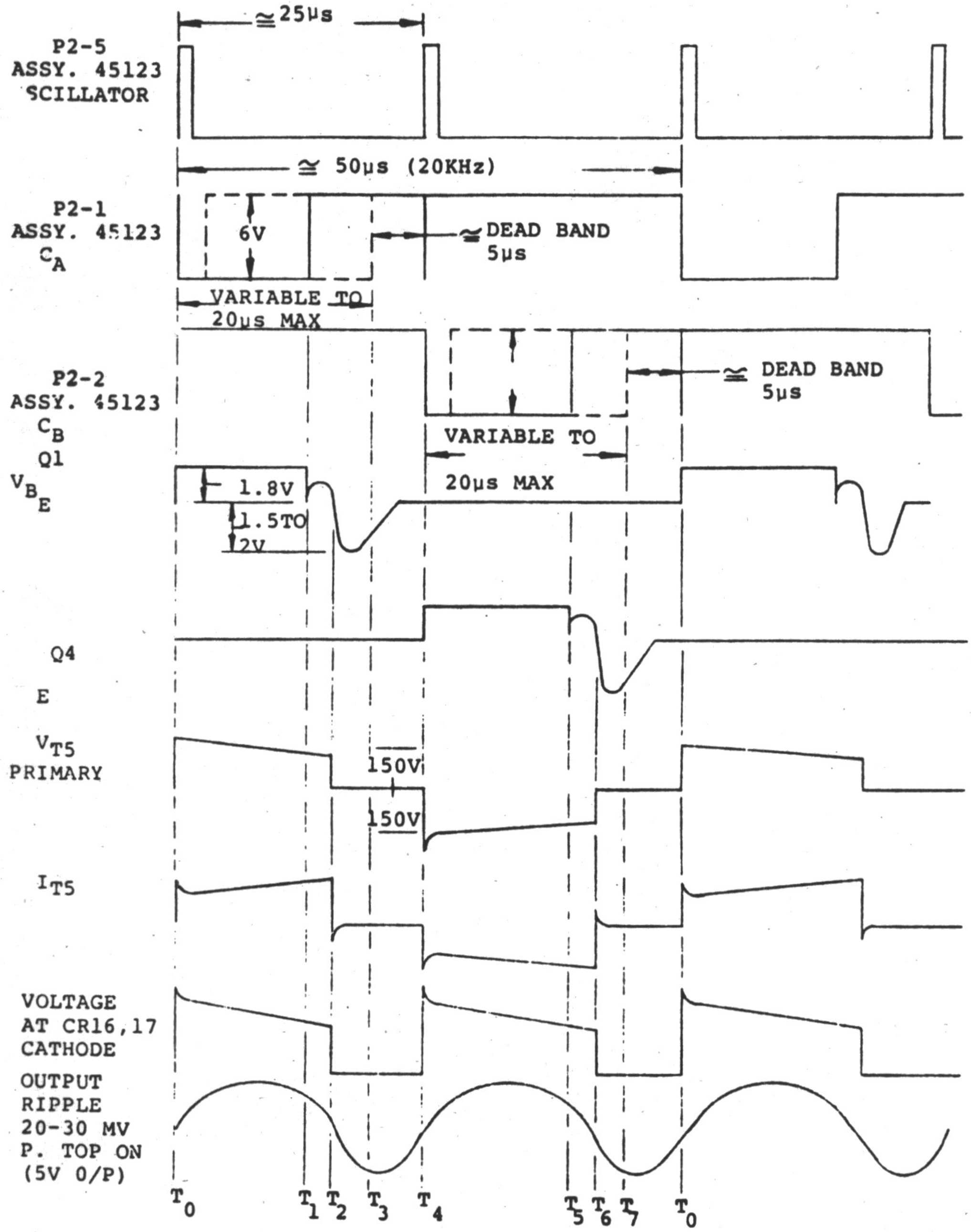
Simplified Transistor Chopper (Half Bridge)
Figure 4.

Table 2 below defines the voltage/current levels at nominal line and load conditions, measured on control module #1.

Table 2

FUNCTION		MEASUREMENT	FUNCTION		MEASUREMENT
P1-1	OVP	2.3V	P2-1	C_A	See Fig. 5
P1-2	Current Limit	Square Wave < 1.4 V Peak	P2-2	C_B	See Fig. 5
			P2-3	Power Fail	3.5-5VDC
P1-3	Current Sense	.8-.9VDC	P2-4	-Sense	0
P1-4	Remote On/Off	1.4VDC	P2-5	OSC, Out	See Fig. 5
P1-5	UVS	12-18VDC	P2-6	+Sense Divider	2.2-2.8VDC
P1-6	+24V Input	22-25VDC	P2-7	R_T	-----
P1-7	Current Lim Bias	.5-.7VDC	P2-8	Common	0

Note: All measurements are made with respect to pins P2-4 or P2-8.



Scope Waveforms
Figure 5

LH RESEARCH	DWG A SIZE	DWG NO. 46360	REV. A

F. Driver Circuit.
Drive to the bridge transistors Q1 and Q4 is provided by two pair of push-pull current source drivers, Q2, Q3, Q5 and Q6. Q3 and Q5 base is held at a 5.1V level. Q2 and Q6 are alternately turned on by C_A and C_B. C_A and C_B levels are clamped at 5.7V by CR9, CR11 and CR10. Transformers T2 and T3 couple drive signals to the base of Q1 and Q4. The snubbers consists of R10, C7 and R16, C8. Resistors R11 and R17 control the drive current.

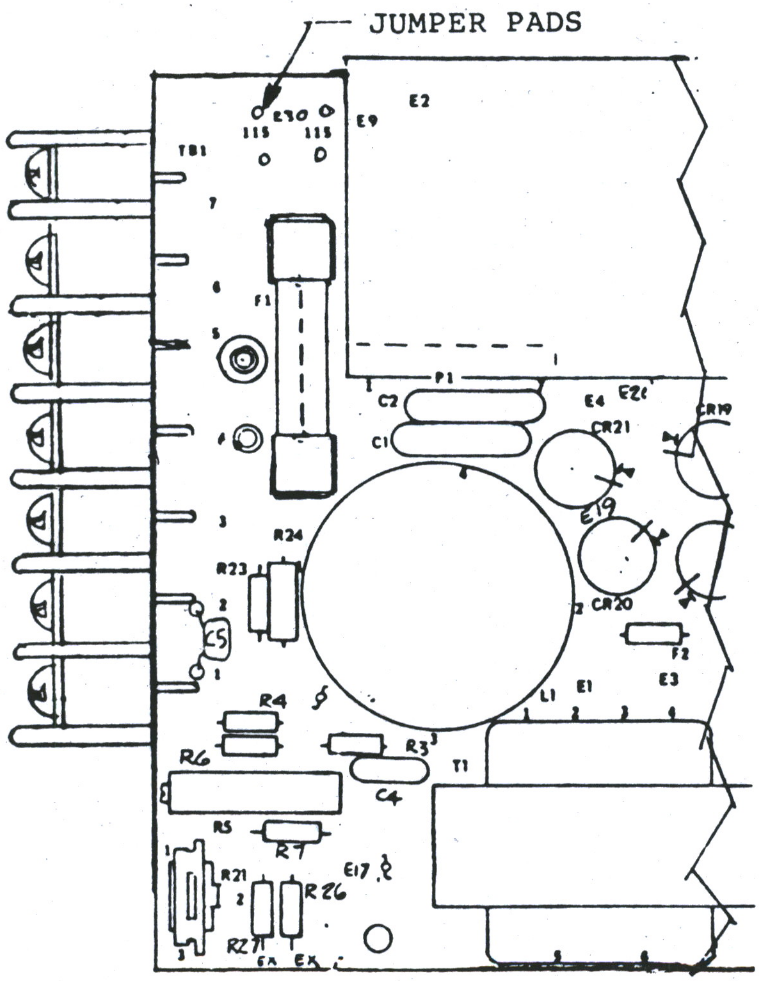
G. Auxiliary Outputs.
Auxiliary outputs V2 through V5 are standard LHR series regulators. V2 through V5 are identical in operation, and only V2 will be described. The quasi-square voltage waveform of 300 volts peak to peak is applied to the primary of T1, and the output is rectified by BR1 and filtered by L1 and C6. R3 and C5 form an RC snubber network. The series pass element consists of an integrated Darlington transistor Q1. Regulator module #1 (45142) contains a reference, voltage sense amplifier and current limit, which are contained in an integrated circuit (LAS 1100). The voltage amplifier drives the base of Q1. The module also contains an overvoltage protection integrated circuit (MC3423) which drives the gate of SCR1. R5 is the current limit sense resistor, and R4 the current fold back resistor. R6, R7 and R8 form the voltage adjust divider. C11, C12 and C13 are filter capacitors. CR1 is the reverse voltage rectifier. R9 is an overvoltage protection sense resistor. Overvoltage and current limit adjusts potentiometers are located on regulator module #1 (45142).

INSTALLATION AND OPERATION

1. The power supply is supplied with mounting provisions that use 8-32 screws. Maximum penetration must not exceed 3/8 inch.

   NOTE: This power supply is designed for fan cooling. Do not restrict cooling air flow.

2. Input voltage requirements are 115VAC or 230VAC±10%, 47-63Hz internally selectable. The unit is factory wired for 115V or 230V line as indicated on the name plate. Power supplies with 115-230VAC input voltage may be operated with either voltage. For 115VAC operation, connect jumpers between pads marked 115. See Figure 5A. For 230VAC operation, remove 2 jumpers from pads marked 115 and connect 1 jumper between pads marked 230.



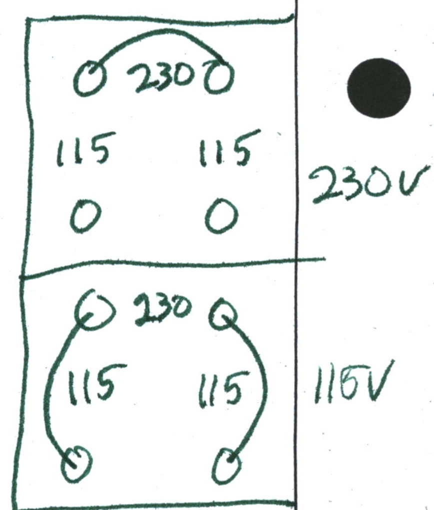


Figure 5A

LH RESEARCH	DWG A SIZE	DWG NO. 46360	REV. A

3. Connect selected input voltage to TB1, AC to terminal 6, AC COMM to terminal 7 and ground to terminal 5.

4. The main voltage V1 output with remote sense can compensate for up to 250mV drop in the leads. To determine the minimum size wire, divide 0.25V by the output current, then divide by the total length of wire in thousands of feet. This gives Ohms per 1000 feet, and a wire table may be consulted to determine the appropriate wire size needed. Some examples are included in the following table:

AWG	OHMS PER 1000 FT. @20°C.
6	0.3951
8	0.6282
10	0.9989
12	1.588
14	2.525
16	4.016
18	6.835

Typical Example:

5V @72A supply connected to the load with 4 foot wires, (with 8 ft. total = .008 thousand ft.), #6 wire would be used to insure less than 250mV drop.

5. Connect plus (+) output stud (main output) to (+) point on load. Connect minus (-) output stud to (-) point on load.

6. Connect +V2 output to (+) point on load. Connect -V2 output to (-) point on load.

7. Connect +V3 output, when applicable, to (+) point on load. Connect -V3 output, when applicable, to (-) point on load.

8. Connect +V4 output, when applicable, to (+) point on load. Connect -V4 output, when applicable, to (-) point on load.

9. Connect +V5 output, when applicable, to (+) point on load. Connect -V5 output, when applicable, to (-) point on load.

10. Power supplies are shipped with the sense leads connected for local sensing.

NOTE: Step 11 will show how to connect for remote sensing.

11. Connect +S1, TB1 terminal 1 (plus sense supply) lead to the (+) point on the main power buss or load.
Connect -S1, TB1 terminal 2 (minus sense supply) lead to the (-) point on the main power buss on load.

NOTE: Sense leads are #22 or #24 twisted pair and must not exceed 10 feet in length.

CAUTION: IF POLARITY OF THE SENSE LEADS ARE REVERSED, THE CONTROL SECTION OF THE POWER SUPPLY WILL BE DAMAGED.

12. Connect power fail lead to TB1 terminal 4. This signal output is referenced to the main output (-) sense.

13. Connect On/Off lead to TB1 terminal 3. The power supply is turned on with open circuit or with TTL logic "1" and is turned off with TTL logic "0" (800mv max.) sinking 400μA referenced to negative sense.

14. Adjust main V1 voltage adjust potentiometer to increase or decrease output voltage. Do not operate the power supply outside its nominal range.

15. Adjust V2 voltage adjust potentiometer to increase or decrease output voltage.

NOTE: Auxiliary output voltage V2, V3, V4 and V5 will not be present unless main output V1 is loaded to a minimum load. The minimum load for 5V main output is 7.5A. For minimum load current on other output voltages contact the factory.

16. Adjust V3 voltage adjust potentiometer, when applicable, to increase or decrease output voltage.

17. Adjust V4 voltage adjust potentiometer, when applicable, to increase or decrease output voltage.

18. Adjust V5 voltage adjust potentiometer, when applicable, to increase or decrease output voltage.

19. Perform the following steps before operating the MM20 power supplies in parallel.

A. Adjust the main output voltage of each power supply within 0.1% of the other. These adjustments must be accomplished at 80 to 90% of full load, with the sense leads tied at the output terminals. The output voltage should be set high enough to allow for the estimated drop in the conductors, (due to load current) beyond the sense terminals.

B. Adjust the current limit on each power supply for 90 to 100% of the rating.

C. The procedures outlined above will insure that the power supplies connected in parallel will share the load current reasonable well throughout its operating range and result in maximum reliability.

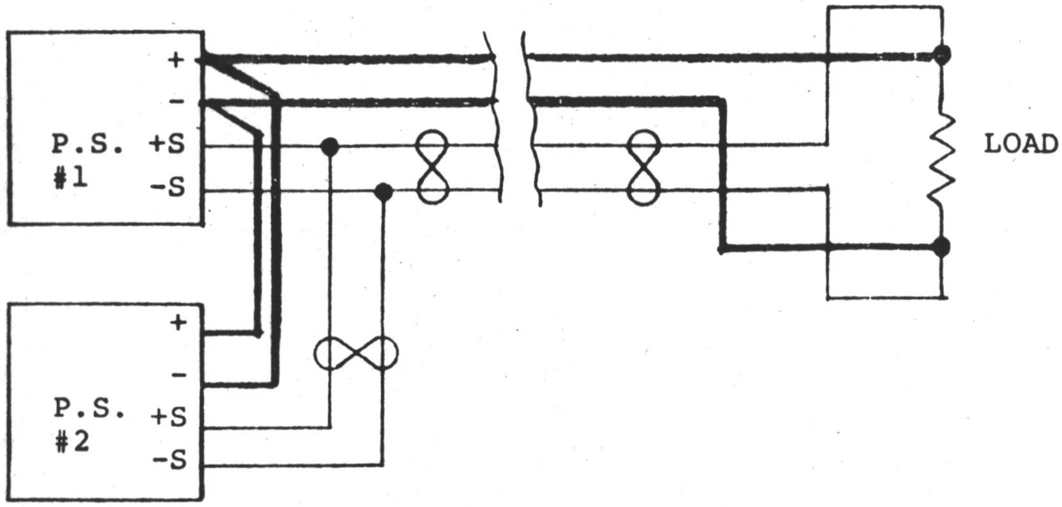
CAUTION: WHEN USING MULTIPLE OUTPUT POWER SUPPLIES IN PARALLEL, INSURE THAT THE TOTAL LOAD ON THE MAIN OUTPUTS IN GREATER THAN THE MINIMUM RATED LOAD OF THESE OUTPUTS. IF THE LOAD CURRENT ON THE MAIN OUTPUT DROPS BELOW THE MINIMUM, THE AUXILIARY OUTPUTS MAY FAIL TO DELIVER RATED LOAD CURRENT.

D. The connection diagrams for power supplies operating in parallel are shown in Figure 6.

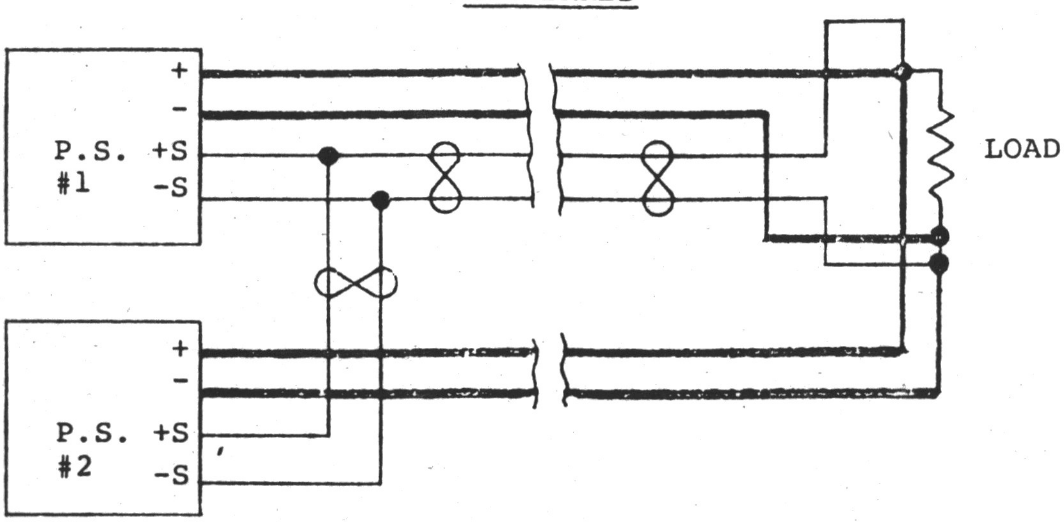
NOTE: The adjustments described below are preset at final test and are for information only. Consult factory when requirements change. Changes in adjustments can cause loss of protective features of this power supply.

20. Adjust main V1 voltage adjust potentiometer clockwise until the output reaches about 20% high. Turning pot R23 on the control module clockwise will make the OVP circuit trigger at a higher voltage. The minimum trigger point is around 20% high. This adjustment is most easily made when the main output is loaded to less than 50% of rating.

ACCEPTABLE



PREFERRED



NOTE: Load conductors should be same size and length, for proper load sharing.

Typical Parallel Diagram
Figure 6

21. With the line set at 115VAC, adjust the current limit pot R12 until the outputs begin to fall with outputs loaded for 375W of total power. This power level should be maintained for no longer than 30 seconds while making this adjustment.

<u>CAUTION</u>: THE OVER CURRENT PROTECTION FOR THE MAIN OUTPUT IS PROVIDED ON THE PRIMARY CURRENT SENSE, WHICH INCLUDES THE REFLECTED LOAD OF BOTH THE MAIN OUTPUT AND AUXILIARY OUTPUTS. ALTHOUGH THE MAIN OUTPUT IS PROTECTED AGAINST OVERLOAD INCLUDING SHORT CIRCUIT ACROSS ITS OUTPUT TERMINALS, DAMAGE MAY RESULT IF THE MAIN OUTPUT IS OPERATED BEYOND ITS SPECIFIED RATING (WITH THE AUXILIARY OUTPUTS LIGHTLY LOADED).

22. Connect scope probe to TB1 terminal 4. Adjust scope for 2V/Cm, 5MS/CM, external trigger. Adjust scope to trigger at AC line turn-off, adjust power fail pot R9, on the control module, until delay between line turn-off and power fail signal fall is greater than 16 Ms. (see specifications).

23. Adjust V2 voltage adjust potentiometer clockwise until the output reaches about 20% high. Turning pot R5 on the series regulator module #1 clockwise will make the OVP circuit trigger at a higher voltage. The minimum trigger point is around 20% high. This adjustment is most easily made when the main output is loaded to less than 50% of rating, but not less than minimum load.

24. When applicable, repeat the above step using V3, V4 and V5 controls.

25. With the line set at 115VAC and V2 output loaded for 115% of rated current, adjust V2 current limit pot R7 on the series regulator module #1 until the output begins to fall. This power level should be maintained for no longer than 30 seconds while making this adjustment.

26. When applicable, repeat the above step using V3, V4 and V5 controls.

TROUBLESHOOTING

1. General

This section describes troubleshooting test analysis routine, and some procedures that are useful in servicing this power supply. Refer to the section on specifications for minimum performance standards.

2. Troubleshooting Procedures

No output voltage will probably be the most common failure mode of this power supply. Make certain the following items are checked before proceeding further:

A. Check to make sure the supply is properly hooked up.

B. Check the AC input voltage at the AC input terminals.

C. Remove the load from the supply to see if the supply will come up under a no-load condition. If it does, this would indicate there may be a short or overload condition in the load.

D. When checking the auxiliary outputs of the multiple output section, make sure there is a 7.5A minimum load on the main output.

3. Troubleshooting Output Filter and Power Output Section

Shorts in the power output section can be determined with an ohmmeter.

Set the meter at the Rx 1 scale. Touch the plus lead to the plus output and the minus lead to the minus output.

Under normal conditions, there should be partial meter deflection and then a gradual increase in resistance as the meter will be charging the output filter capacitors.

If there is an internal short, the meter will read a very low resistance. When the meter leads are reversed, you will normally read a very low resistance because of the low forward resistance of the rectifiers. If a short is present, this could mean a shorted output rectifier or a shorted output filter capacitor. To check the rectifiers it will be necessary to remove the rectifier from the power supply assembly. The rectifiers can then be checked with an ohmmeter.

WARNING: ALWAYS MAKE SURE THE POWER SUPPLY HAS BEEN TURNED OFF FOR AT LEAST TWO MINUTES BEFORE WORKING INSIDE THE UNIT TO ALLOW THE VOLTAGE TO DISCHARGE FROM THE INPUT CAPACITORS.

4. Troubleshooting Input Section

Check the internal AC fuse F1 and if blown, replace with the same type and value. If the fuse blows again, it indicates a short in the AC input section.

If the supply continues to blow the AC input fuse when power is applied, check the diodes mounted on the control board with an ohmmeter. Check the input filter capacitors for possible shorted conditions.

If the AC is present to the rectifiers and the high voltage is missing at the filter capacitors, check for an open thermistor. The proper voltage across the input capacitors C1 and C2 with nominal input voltage, should be about 150 volts DC across each capacitor. If there is no voltage across the input capacitor, check for an open connection. Examine the thermistors R1 and R2. The resistance of these thermistors should read about 2.5 ohms or 5 ohms when cool.

If normal voltage is present on input capacitors, check the DC fuses between the high voltage capacitors and the power transistors. If open, it will most likely indicate a power transistor failure or an internal short. Check the power transistors and clamp diodes for shorts. A shorted clamp diode maybe the cause of power transistor failure.

If a replacement power transistor is required, it is recommended that they are all replaced with a new tested set from LH Research. For optimum performance, the set is matched for storage time and switching speed.

When replacing power transistors, make certain the insulators are thoroughly greased with a thermal compound, and the mounting surfaces are free of burrs and foreign materials. Recheck the clamping diodes across emitter to collector of the power transistors to be sure none are shorted. Check the power transistor base voltage waveforms per step 5.

5. Check Power Transistor Base Voltage Waveforms

Set oscilloscope vertical sensitivity to .5V/Div. Set sweep to 5μs/Div. Remove the internal fuses F3 and F4. This will remove the 300 volts from the power switching transistors.

CAUTION: BEFORE MAKING ANY OSCILLOSCOPE MEASUREMENT, ISOLATE THE SCOPE CHASSIS FROM THE AC LINE WITH AN ISOLATION PLUG OR TRANSFORMER, MAKING SURE THAT THE SCOPE CHASSIS IS ISOLATED FROM EARTH GROUND. SCOPE CHASSIS MAY BE ELECTRICALLY HOT WHILE MAKING THE FOLLOWING MEASUREMENTS.

Observe the base-emitter voltage waveform on Q1 and Q4 by hooking scope across transistor with scope ground on emitter side of transistor. See Figure 5 for proper waveform. Turn the AC power off and replace the DC fuses F3 and F4.

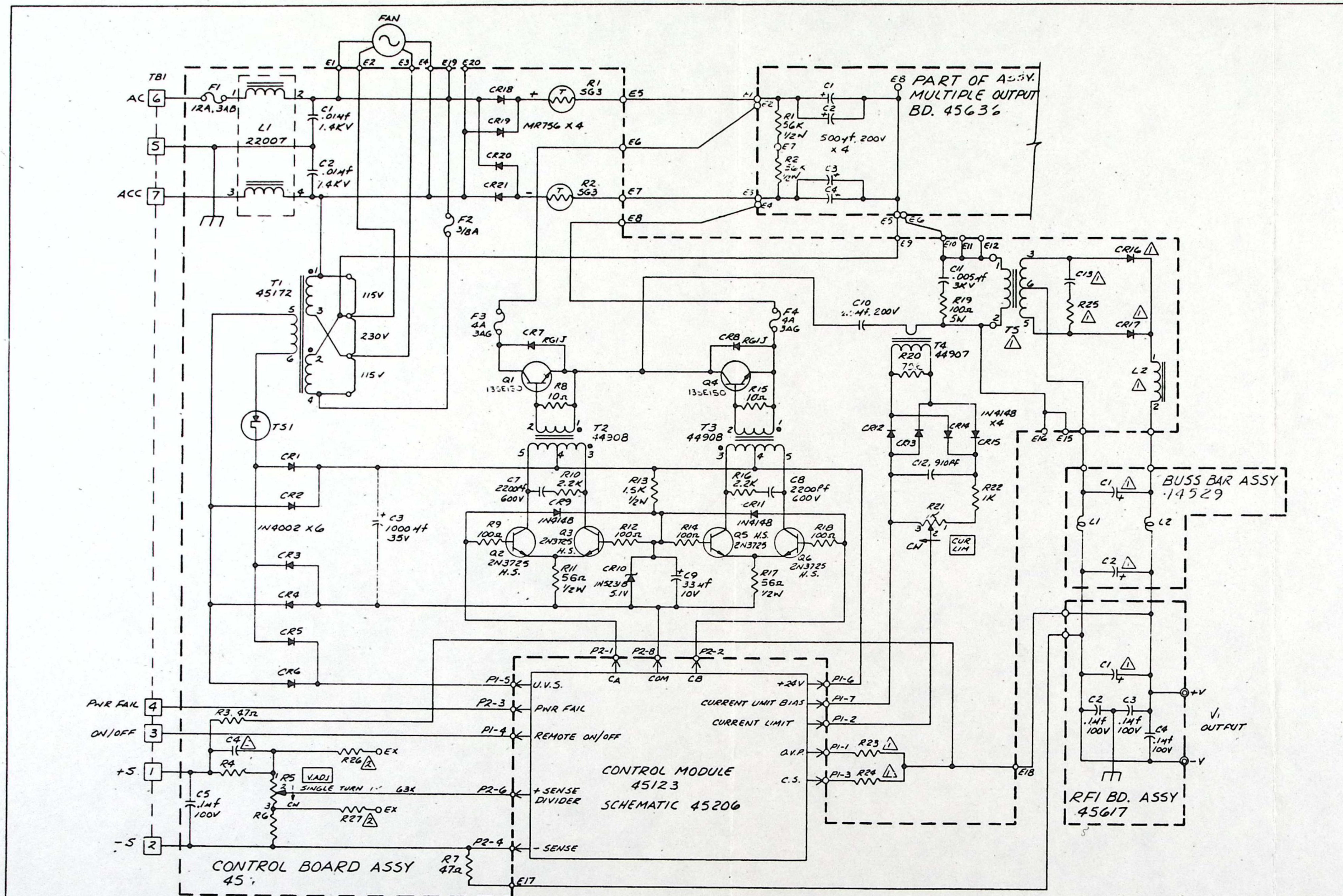
If no basic voltage waveforms are present, check the +24 volts on the control board. With reference to the minus main output terminal, the 24 volts should be between 22 and 25 volts.

If the voltage is low or none, check fuse F2. If the fuse is open, check CR1, 2, 3, 4, 5 and 6 for possible short. If the diodes are good, replace F2 with same type and value.

If the fuse blows again or the base voltage waveforms are not present, the unit should be returned to the factory for repairs.

(Pages 25 thru 29 deleted.)

REV	DESCRIPTION	DATE	APPROVED
NC	ENGINEERING RELEASED		
A	PRODUCTION RELEASED	[illegible]	[illegible]
A1	CHG'D PER ECN 2621	[illegible]	[illegible]
B	CHANGED PER ECN 3003	[illegible]	[illegible]



B. FOR PARALLEL OPERATION OF SECONDARY OUTPUTS (V2 & V3)
1. CONNECT W1
2. JUMPER OUTPUTS TB-2, 2 TO 6; 3 TO 7
3. USE TB-2 TERMINALS 1 & 4 ONLY FOR REMOTE SENSE. LEAVE TB-2 5 & 8 OPEN
4. COMPONENTS NOT USED: MOD. 2, R16 - R22, C16, SCR2
5. DERATE TOTAL OUTPUT TO 80%.

3. A. FOR NORMAL OPERATION OF THE TWO INDEPENDENT SECONDARY OUTPUTS (V2 & V3) CONNECT W2

2 COMPONENT NOT USED IN STANDARD ASSY.

1 COMPONENTS VARY WITH OUTPUT VOLTAGES, SEE APPROPRIATE ASSY. DASH NO. FOR CORRECT VALUE

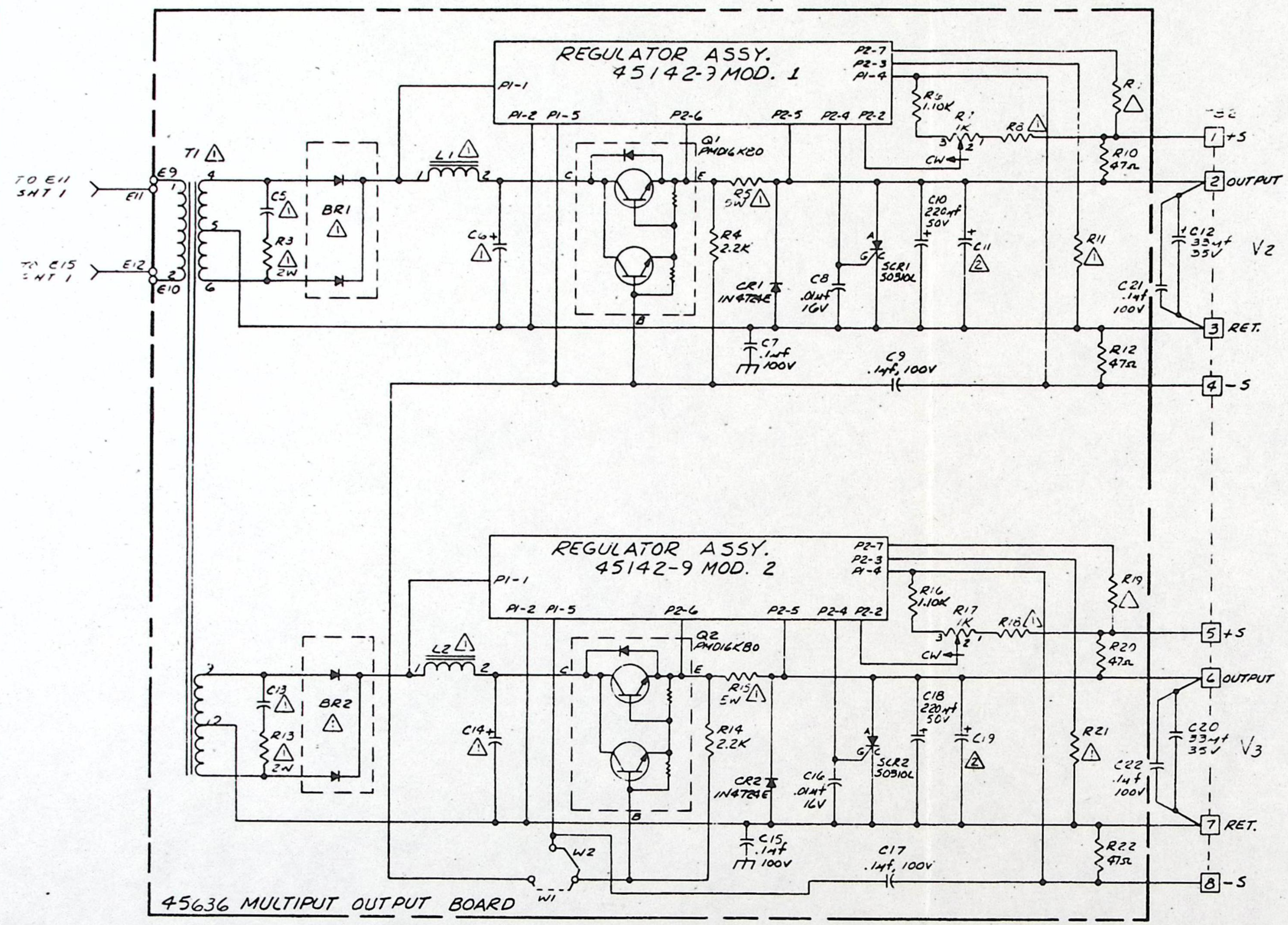
NOTES: UNLESS OTHERWISE SPECIFIED

PROPRIETARY

DRAFTSMAN	[signature]
DATE	3 OCT 77
CHECKER	[signature]
APPR.	M.I.
USED ON	MH23
NEXT ASS'Y	
APPLICATION	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES	
TITLE	SCHEMATIC, POWER SUPPLY
SIZE	D
PRODUCT CODE	REF
DWG NO.	45632
REV.	B
SCALE	NONE
SHEET	1 OF 2 SHEETS

LH RESEARCH

REV	DESCRIPTION	DATE	APPROVED
	SEE SHEET 1		



MOD. 2	
T1	
SCR2	
R22	
Q2	
CR2	
C22	
L2	
BR2	
LAST DES. USED	DES. NOT USED
45636	

PROPRIETARY

LH RESEARCH

SCHEMATIC
POWER SUPPLY

HM25
NEXT ASSY | USED ON
APPLICATION

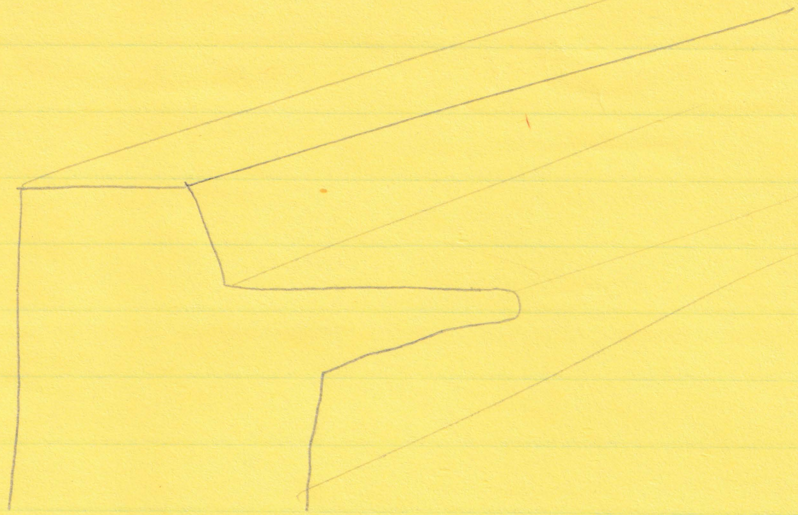
SIZE D | DWG NO. 45632 | REV. B

SHEET 2 OF 2 SHEETS

V[illegible]B 1

VRG 2

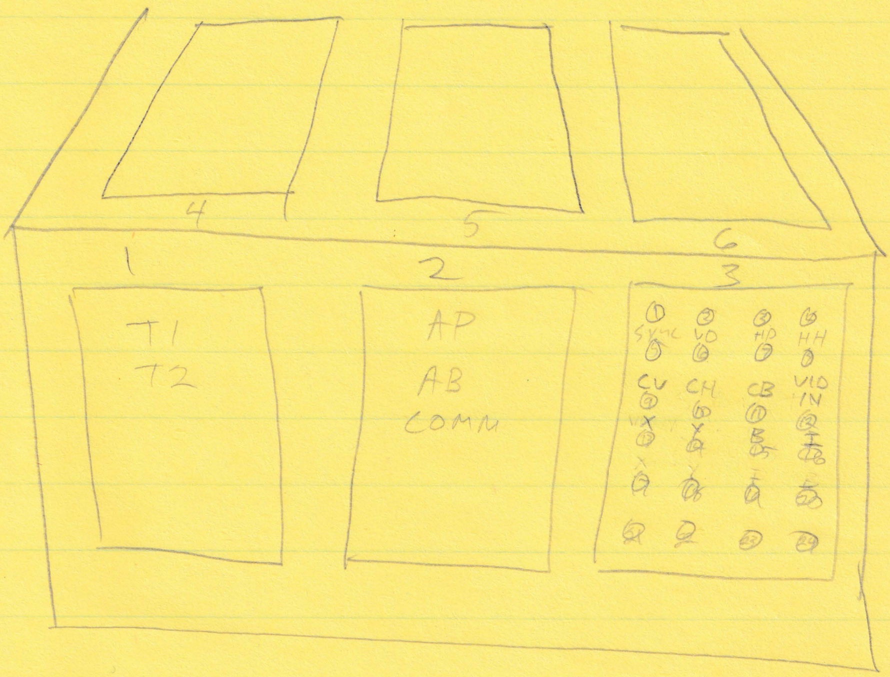
VUG 3



VRM 4

VCR 5

VFD 6



VAO 7

VAO 8

VAO 9

10

11

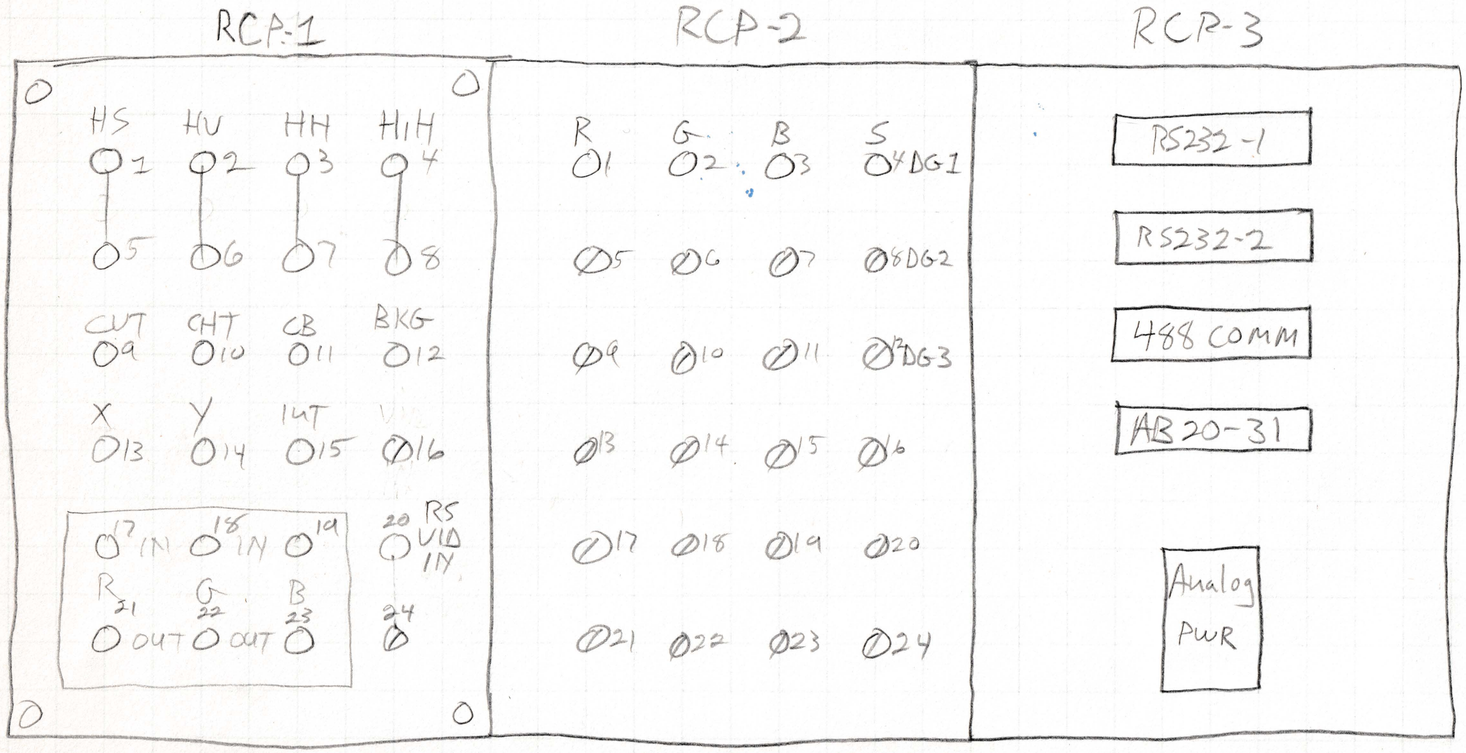
mem 12

13

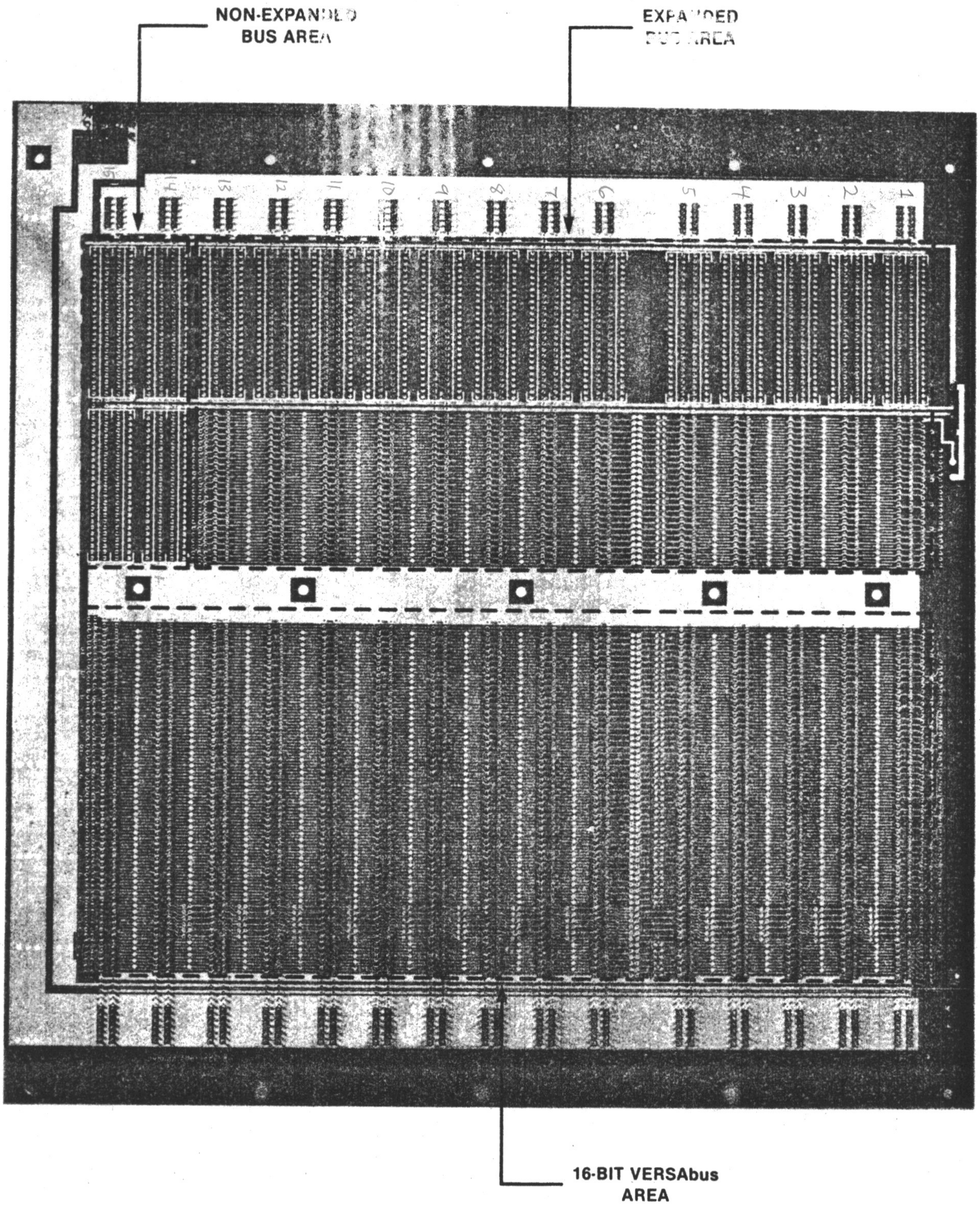
FDC in Master

64R 14

V[illegible] 15



RCP-1
RCP-2
RCP-3
HS
HU
HH
HIH
CUT
CHT
CB
BKG
X
Y
IUT
IN
IN
R
G
B
OUT
OUT
RS
VID
IN
R
G
B
S
DG1
DG2
DG3
RS232-1
RS232-2
488 COMM
AB 20-31
Analog
PWR



1-82-972

FIGURE 3-4. Backplane Bottom View

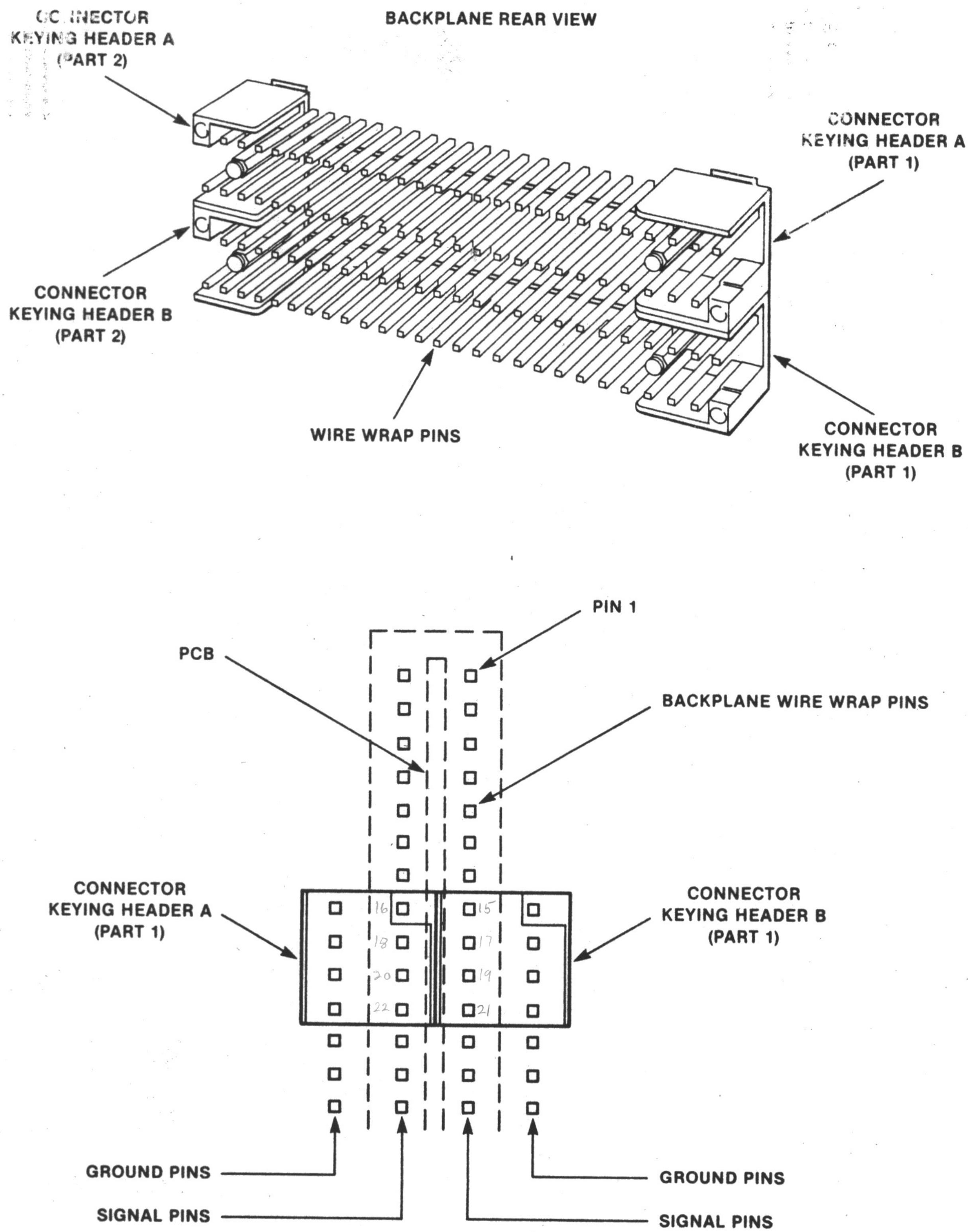
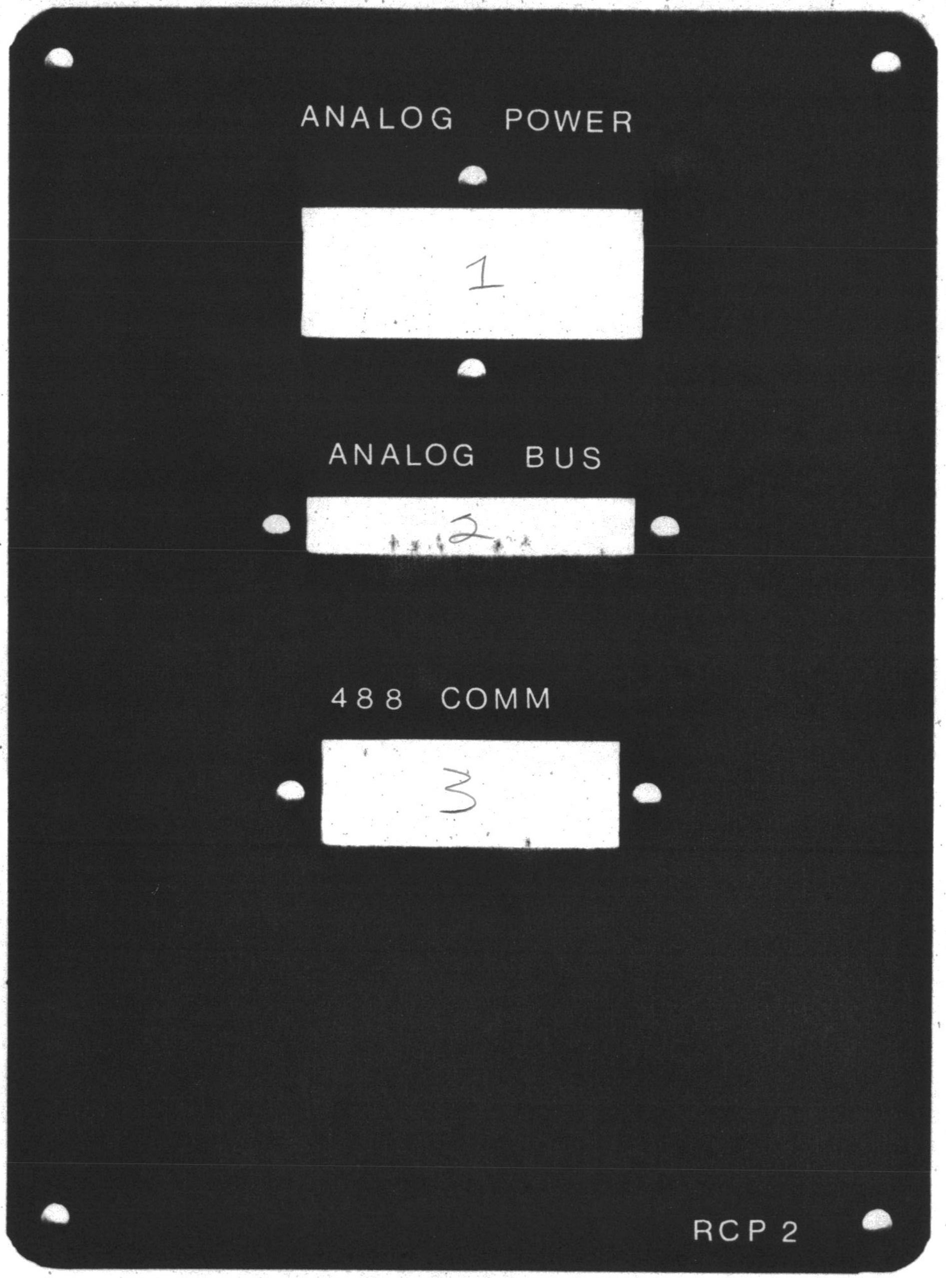


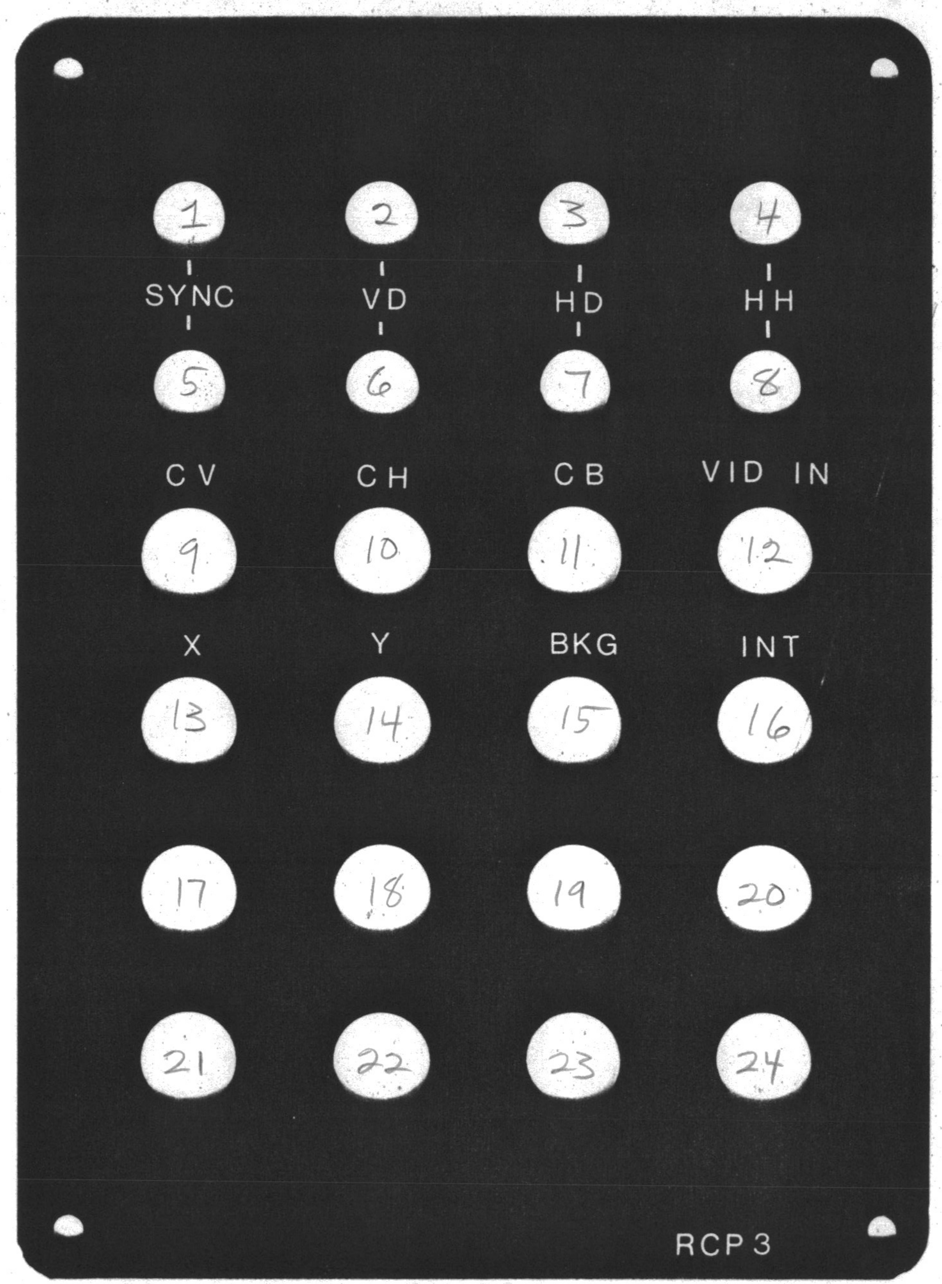
FIGURE 3-14. Dual Cable - Keying Header Configuration

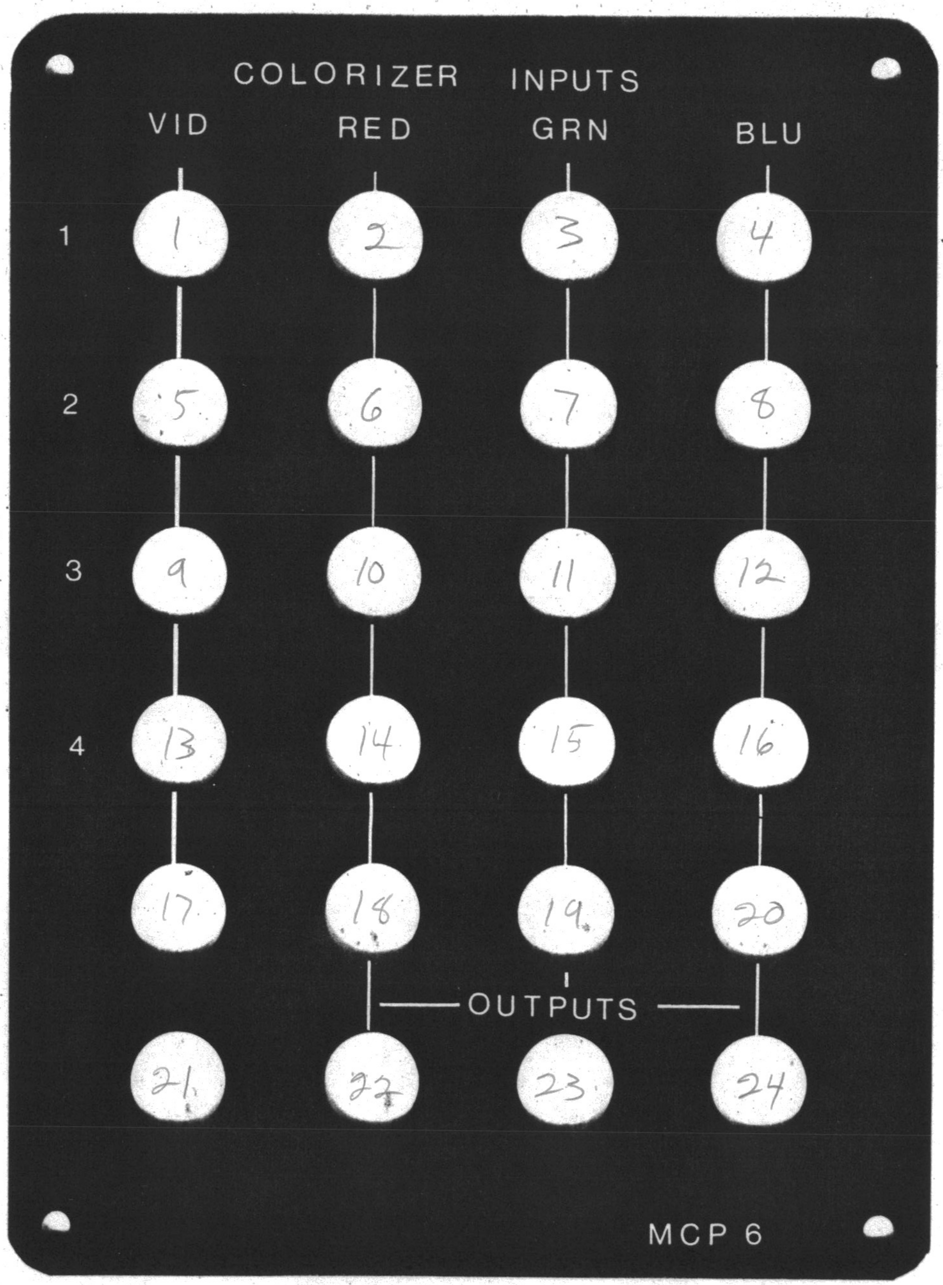
Backplane Modifications

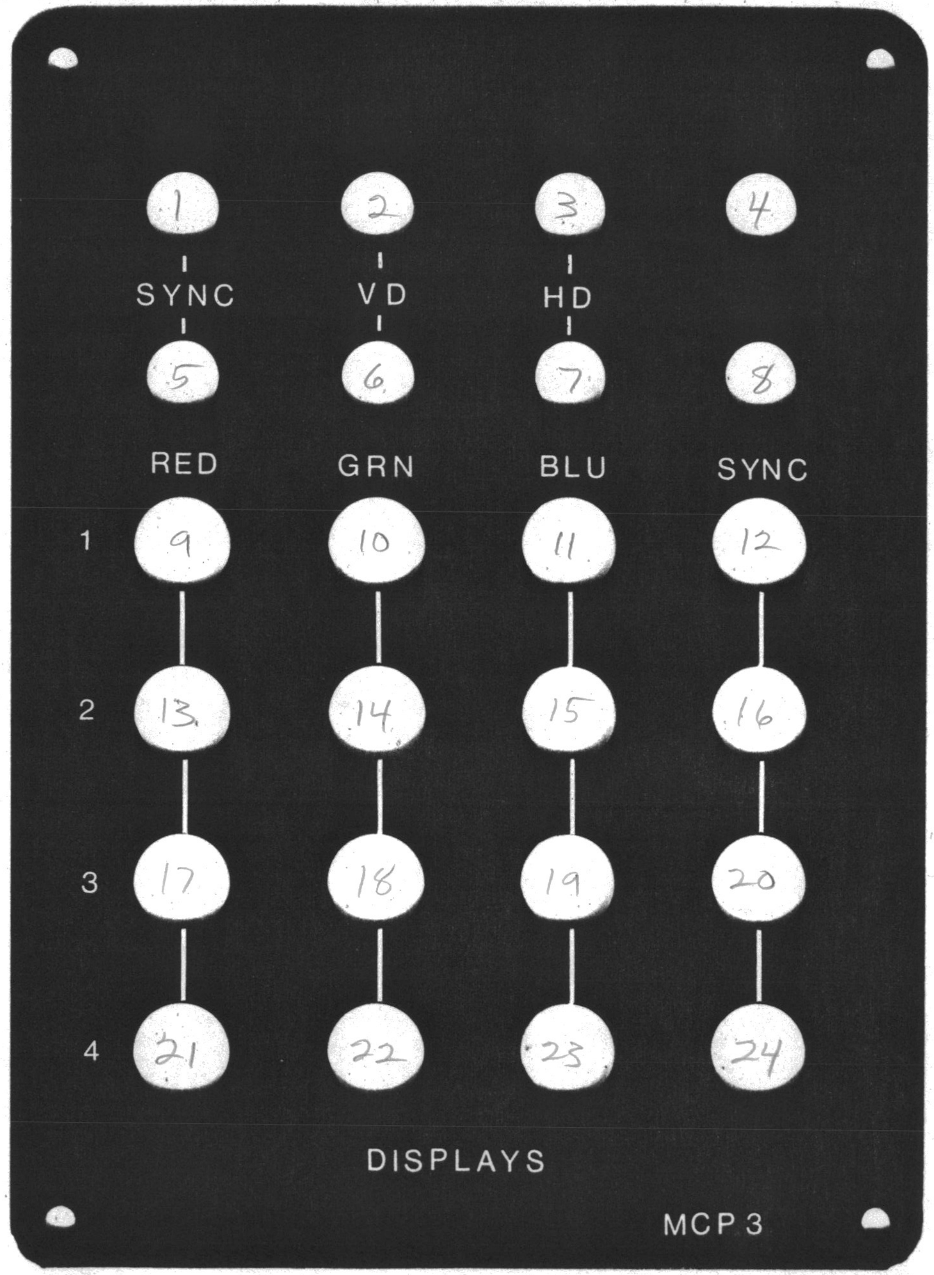
1. Remove Z ramp from P3 (VVG) pin 51. Jumper pin 51 to VRG pin 43. (H Ramp)

2. Add Jumper from VVG pin 47 to VTB pin 31.


ANALOG POWER
1
ANALOG BUS
2
488 COMM
3
RCP 2


1
2
3
4
SYNC
VD
HD
HH
5
6
7
8
CV
CH
CB
VID IN
9
10
11
12
X
Y
BKG
INT
13
14
15
16
17
18
19
20
21
22
23
24
RCP3


COLORIZER INPUTS
VID RED GRN BLU
1 2 3 4
1 2 3 4
5 6 7 8
9 10 11 12
13 14 15 16
17 18 19 20
OUTPUTS
21 22 23 24
MCP 6


1 2 3 4
SYNC VD HD
5 6 7 8
RED GRN BLU SYNC
1 2 3 4
9 10 11 12
13 14 15 16
17 18 19 20
21 22 23 24
DISPLAYS
MCP 3

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering parts. Abbreviations used in the parts list are in table 6-1. Table 6-2 lists the parts in alphanumeric order by reference designation and includes the manufacturer and manufacturer's part number. Table 6-3 lists replaceable parts for available options. Table 6-4 lists manufacturers' code numbers.

6-3. REPLACEABLE PARTS LIST.

6-4. Table 6-2 is the list of replaceable parts and is organized as follows:

a. List of electrical assemblies.

b. Chassis-mounted parts in alphanumerical order by reference designation.

c. Electrical assemblies and their components in alphanumerical order by reference designation.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) in the instrument.

c. The description of the part.

d. A typical manufacturer of the part in a five-digit code.

e. The manufacturer's number for the part.

The total quantity for each part is given only once—at the first appearance of the part number in the list.

6-6. ORDERING INFORMATION.

6-6. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-7. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-8. SPARE PARTS KIT.

6-9. Stocking spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has a Spare Parts Kit available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the Recommended Spares List are based on failure reports and repair data, and parts support for one year. A Recommended Spares List for this instrument may be obtained on request and the Spare Parts Kit may be ordered through your nearest Hewlett-Packard office.

6-10. DIRECT MAIL ORDER SYSTEM.

6-11. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

a. Direct ordering and shipment from the HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

d. No invoices—to provide these advantages, a check or money order must accompany each order.

6-12. Mail order forms and specific ordering information are available through your local HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Reference Designators and Abbreviations

REFERENCE DESIGNATORS

A	= assembly
B	= motor
BT	= battery
C	= capacitor
CP	= coupler
CR	= diode
DL	= delay line
DS	= device signaling (lamp)
E	= misc electronic part
F	= fuse
FL	= filter
IC	= integrated circuit
J	= jack
K	= relay
L	= inductor
LS	= loud speaker
M	= meter
MK	= microphone
MP	= mechanical part
P	= plug
Q	= transistor
R	= resistor
RT	= thermistor
S	= switch
T	= transformer
TB	= terminal board
TP	= test point
U	= integrated circuit
V	= vacuum, tube, neon bulb, photocell, etc
VR	= voltage regulator
W	= cable
X	= socket
Y	= crystal
Z	= tuned cavity network

ABBREVIATIONS

A	= amperes
AFC	= automatic frequency control
AMPL	= amplifier
BFO	= beat frequency oscillator
BE CU	= beryllium copper
BH	= binder head
BP	= bandpass
BRS	= brass
BWO	= backward wave oscillator
CCW	= counter-clockwise
CER	= ceramic
CMO	= cabinet mount only
COEF	= coeficient
COM	= common
COMP	= composition
COMPL	= complete
CONN	= connector
CP	= cadmium plate
CRT	= cathode-ray tube
CW	= clockwise
DEPC	= deposited carbon
DR	= drive
ELECT	= electrolytic
ENCAP	= encapsulated
EXT	= external
F	= farads
FH	= flat head
FIL H	= fillister head
FXD	= fixed
G	= giga (10^9)
GE	= germanium
GL	= glass
GRD	= ground(ed)

H	= henries
HDW	= hardware
HEX	= hexagonal
HG	= mercury
HR	= hour(s)
HZ	= hertz
IF	= intermediate freq
IMPG	= impregnated
INCD	= incandescent
INCL	= include(s)
INS	= insulation(ed)
INT	= internal
K	= kilo=1000
LH	= left hand
LIN	= linear taper
LK WASH	= lock washer
LOG	= logarithmic taper
LPF	= low pass filter
M	= milli=10^{-3}
MEG	= meg=10^6
MET FLM	= metal film
MET OX	= metallic oxide
MFR	= manufacturer
MHZ	= mega hertz
MINAT	= miniature
MOM	= momentary
MOS	= metal oxide substrate
MTG	= mounting
MY	= "mylar"
N	= nano (10^{-9})
N/C	= normally closed
NE	= neon
NI PL	= nickel plate

N/O	= normally open
NOM	= nominal
NPO	= negative positive zero (zero temperature coefficient)
NPN	= negative-positive-negative
NRFR	= not recommended for field replacement
NSR	= not separtely replaceable
OBD	= order by description
OH	= oval head
OX	= oxide
P	= peak
PC	= printed circuit
PF	= picofarads= 10^{-12} farads
PH BRZ	= phosphor bronze
PHL	= phillips
PIV	= peak inverse voltage
PNP	= positive-negative-positive
P/O	= part of
POLY	= polystyrene
PORC	= porcelain
POS	= position(s)
POT	= potentiometer
PP	= peak-to-peak
PT	= point
PWV	= peak working voltage
RECT	= rectifier
RF	= radio frequency
RH	= round head or right hand

RMO	= rack mount only
RMS	= root-mean square
RWV	= reverse working voltage
S-B	= slow-blow
SCR	= screw
SE	= selenium
SECT	= section(s)
SEMICON	= semiconductor
SI	= silicon
SIL	= silver
SL	= slide
SPG	= spring
SPL	= special
SST	= stainless steel
SR	= split ring
STL	= steel
TA	= tantalum
TD	= time delay
TGL	= toggle
THD	= thread
TI	= titanium
TOL	= tolerance
TRIM	= trimmer
TWT	= traveling wae tube
U	= micro=10^{-6}
VAR	= variable
VDCW	= dc working volts
W/	= with
W	= watts
WIV	= working inverse voltage
WW	= wirewound
W/O	= without

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	01332-66509	1	BOARD ASSY, MAIN	28480	01332-66509
A2	01335-66512	1	BOARD ASSY, X-Y	28480	01335-66512
A3	01332-66508	1	BOARD ASSY, HIGH VOLTAGE	28480	01332-66508
A4			NOT ASSIGNED		
A5	01332-66505	1	BOARD ASSY, CONTROL	28480	01332-66505
A6	0960-0383	1	HIGH VOLTAGE MULTIPLIER ASSY	28480	0960-0383
DS1	1450-0746	1	LIGHT; IND; INCANDESCENT: WHT OPA LENS	28480	1450-0746
E1	0340-0564	3	INSULATOR: XSTR	05447	7403-10-51
E2	0340-0565	1	INSULATOR: XSTR	05447	7403-10-50
F1	2110-0063	1	FUSE .75A 250V (120 VAC OPERATION)	71400	AGC-3/4
F1	2110-0065	1	FUSE .375A 250V (220 VAC OR 240 VAC OPERATION)	71400	AGC-3/8
H1	2190-0019	2	WASHER-LK HLCL NO. 4 .115 IN ID	04604	OBD
H2	2360-0115	25	SCREW-MACH 6-32 .312-IN-LG PAN HD	28480	2360-0115
H3	2360-0197	3	SCREW-MACH 6-32 .375-IN-LG PAN HD	28480	2360-0197
H4	2190-0909	3	WASHER-LK NO. 6 .146 IN ID .333 IN OD	04713	04A52200F02
H5	2200-0145	1	SCREW-MACH 4-40 .438-IN-LG PAN HD	28480	2200-0145
H6	3050-0235	7	WASHER-FL MTLC NO. 4 .117 IN ID .25 IN OD	28480	3050-0235
H7	2260-0001	5	NUT-HEX-DBL CHAM 4-40-THD .094-THK	28480	2260-0001
H8	2360-0117	1	SCREW-MACH 6-32 .375-IN-LG PAN HD	28480	2360-0117
H9	3050-0010	2	WASHER-FL MTLC NO. 6 .147 IN ID .312 IN OD	28480	3050-0010
H10	0360-0001	1	TERMINAL, SLDR LUG, 6 SCR, .141/.086 ID	78452	920
H11	2360-0121	1	SCREW-MACH 6-32 .5-IN-LG PAN HD	28480	2360-0121
H12	2200-0550	2	SCREW-MACH 4-40 2.500-IN-LG PAN HD	28480	2200-0718
H13	1200-0081	2	INSULATOR, BSHG, FLG .115 ID	26365	974-307
H14	2190-0008	2	WASHER-LK EXT T NO. 6 .141 IN ID .32 IN OD	78189	1806-00
H15	1400-0325	1	CLAMP, CABLE .125 DIA .375 W NYL	06915	N-2
H16	3050-0066	2	WASHER-FL MTLC NO. 6 .147 IN ID .375 IN OD	28480	3050-0066
H17	1400-0023	1	CLAMP-CA .5-IN-WD NYL	28520	3329
H18	2360-0113	1	SCREW-MACH 6-32 .25-IN-LG PAN HD	28480	2360-0113
H19			NOT ASSIGNED		
H20	2200-0139	2	SCREW-MACH 4-40 .25 IN LG PAN HD	28480	2200-0139
H21			NOT ASSIGNED		
H22			NOT ASSIGNED		
H23	2360-0194	1	SCREW-MACH 6-32 .312-IN-LG 100 DEG FL-HD	28480	2360-0194
H24	2510-0192	8	SCREW-MACH 8-32 100 DEG FL HD	04866	YELLOW PATCH
H25	1400-0090		WASHER-RUBBER 5/8" OD	00000	OBD
H26	2190-0037		WASHER-LK INTL T NO. 1/2 .512 IN ID .789 IN OD	78189	1224-08
H27	2950-0038	1	NUT-SPECIALTY 1/2-24-THD .125-THK	75915	903-12
H28	2950-0035	2	NUT-HEX-DBL CHAM 15/32-32-THD .078-THK	28480	2950-0035
H29	2190-0054	4	WASHER-LK INTL T NO. 1/2 .505 IN ID .63 IN OD	78189	1924-12
H30	2190-0102	1	WASHER-LK INTL T NO. 7/16 .472 IN ID	78189	1222-09
H31	2950-0054	4	NUT-HEX-DBL CHAM 1/2-28-THD .125-THK	28480	2950-0054
H32	2200-0143	16	SCREW-MACH 4-40 PAN HD SST	28480	2200-0143
H33	2950-0072	4	NUT-HEX-DBL CHAM 1/4-32-THD .062-THK	82389	P-1975
H34	2200-0103	3	SCREW-MACH 4-40 .25-IN-LG PAN HD	28480	2200-0103
H35	0520-0127	2	SCREW-MACH 2.56 .188-IN-LG PAN HD	28480	0520-0127
H36	0570-1171	2	SCREW-COVER MTG 6-32 .460 IN LG	01136	OBD
H37	0510-0043	2	RETAINER-RING .141-DIA.	01419	1500-14-CD
H38	2200-0101	2	SCREW-MACH 4-40 .188 IN LG PAN HD POZI	04771	E2139
J1	1250-0118	7	CONNECTOR-BNC +Y	24931	28JR 128-1
J2 (OPT 105, 106)	1250-0118		CONNECTOR-BNC −Y	24931	28JR 128-1
J3	1250-0118		CONNECTOR-BNC +X	24931	28JR 128-1
J4 (OPT 105, 106)	1250-0118		CONNECTOR-BNC −X	24931	28JR 128-1
J5	1250-0118		CONNECTOR-BNC Z	24931	28JR 128-1
J6 (OPT 205, 206)	1250-0118		CONNECTOR-BNC Z	24931	28JR 128-1
J7 (OPT 216)	1250-0118		CONNECTOR-BNC Z	24931	28JR 128-1
J8 (OPT 324)	1251-0218	1	CONNECTOR: REMOTE PROGRAM	28480	1251-0218
L1	01332-66001	1	COIL, TRACE ALIGN	28480	01332-66001
L2	01701-66001	1	COIL, ORTHO	28480	01701-66001
MP1	0370-2785	4	KNOB; CONC, RND; 0.5-IN; JGK, SGI DECAL	28480	0370-1121
MP2	01332-02702	1	FILTER, BLUE	28480	01332-02706
MP2 (OPT 330, 561)	01332-02703	1	FILTER, CLEAR	28480	01332-02707
MP2 (OPT 007 607)	01332-02704	1	FILTER, AMBER	28480	01332-02708
MP3	1220-0203	1	SHIELD, CRT	28480	1220-0203
MP4 (OPT 315, 330, 580)	1460-1345	2	SPRING WFRM 3-LG SST	28480	1460-1345
MP5	1490-0841	4	DRIVE; SFT CPLR .127 ID .281 OD .375 L	28480	1490-0841
MP6	5001-0439	2	TRIM, FRONT SIDE	28480	5001-0439
MP7	5020-8815	1	CASTING, FRONT FRAME	28480	5020-8815
MP8	5020-8816	1	CASTING, REAR FRAME	28480	5020-8816
MP9	5020-8837	3	SIDE RAIL	28480	5020-8837
MP10 (OPT 315, 330, 580)	5040-7201	4	FOOT	28480	5040-7201
MP11	5040-7203	1	TRIM: TOP FRONT	28480	5040-7203
MP12	6960-0002	4	PLUG, HOLE, STANDARD HD, .5 DIA STEEL	57771	D-2733-LCS
MP13	01335-04102	1	COVER-HV	28480	01335-04102

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
MP14 (OPT 315, 580)	5061-1931	1	COVER, TOP	28480	5061-1931
MP15 (OPT 315, 330, 580)	5061-1922	1	COVER, BOTTOM	28480	5061-1922
MP16 (OPT 323)	01332-07204	1	INSERT, LEFT	28480	01332-07204
MP16	01332-07201	1	INSERT, LEFT	28480	01332-07201
MP17	01332-07205	1	INSERT, RIGHT	28480	01332-07205
MP17 (OPT 325)	01332-07206	1	INSERT, RIGHT (OPTION 325)	28480	01332-07206
MP18	01335-23703	1	SHAFT-Y GAIN	28480	01335-23703
MP19	01335-23702	1	SHAFT-X GAIN	28480	01335-23702
MP20	01335-23701	2	SHAFT-TA/AST	28480	01335-23701
MP21	01335-60103	1	CHASSIS ASSY	28480	01335-60103
MP22	01332-60201	1	PANEL ASSY, REAR	28480	01332-60201
MP23			NOT ASSIGNED		
MP24			NOT ASSIGNED		
MP25	01332-02201	1	BEZEL, CRT	28480	01332-02201
MP26	5001-1035		COVER-INPUT	28480	5001-1035
MP27 (OPT 106, 206, 216)	1250-0929		SHORTING CAP-BNC	03316	28PC104-1
MP28	5040-8118	1	PANEL ASSY FRONT	28480	5040-8118
MP28 (OPT 562)	5040-0526	1	PANEL ASSY FRONT	28480	5040-0526
MP29	5040-7620	1	COVER-PANEL	28480	5040-7620
MP30	01335-01204	1	BRACKET, CRT SHIELD	28480	01335-01204
MP31	01335-01205	1	BRACKET, TRANSFORMER	28480	01335-01205
MP32	5020-0063	1	CUSHION	28480	5020-0063
MP33	0905-0573	1	GASKET, ROUND	28480	0905-0573
P1	1251-4470	1	CONN AC POWER H-9 MALE FLANGE (P/O MP22)	28480	1251-4470
Q1	1854-0433	3	TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
Q2	1854-0433		TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
Q3	1854-0330	1	TRANSISTOR NPN SI PD=21W FT=10MHZ	02037	SJE901
Q4	1854-0433		TRANSISTOR NPN SI PD=90W FT=2MHZ	02037	SJE913
S1	3101-0056	1	SWITCH; TGL; DPDT 10A/250V AC ON NONE	27191	8926R316
S2	3101-1609	1	SWITCH: DUAL DPDT	28480	3101-1609
T1	9100-0676	1	TRANSFORMER POWER; 4 SECTION	28480	9100-0676
T1 (OPT 310)	9100-0677	1	TRANSFORMER; POWER	28480	9100-0677
V1	5083-4152	1	CRT, P31 AL STANDARD	28480	5083-4152
V1 (OPT 007)	5083-4132	1	CRT, P7 ALUMINIZED WITH GRATICULE AND FILTER	28480	5083-4132
V1 (OPT 011)	5083-4142	1	CRT, P11 ALUMINIZED WITH GRATICULE EXCEPT WITH OPTION 570	28480	5083-4142
V1 (OPT 631)	5083-4151	1	CRT, P31 ALUMINIZED NO GRATICULE EXCEPT WITH OPTION 570	28480	5083-4151
V1 (OPT 607)	5083-4131	1	CRT, P7 ALUMINIZED WITH FILTER NO GRATICULE	28480	5083-4131
V1 (OPT 611)	5083-4141	1	CRT, P11 ALUMINIZED, NO GRATICULE	28480	5083-4141
V1 (OPT 639)	5083-4170	1	CRT, P39 ALUMINIZED, NO GRATICULE	28480	5083-4170
V1 (OPT 039)	5083-4171	1	CRT, P39 ALUMINIZED WITH GRATICULE	28480	5083-4171
V1 (OPT 570)	5083-4173	1	CRT, P31 ALUMINIZED, NO GRATICULE	28480	5083-4173
V1 (OPT 570)	5083-4174	1	CRT, P11 ALUMINIZED, NO GRATICULE	28480	5083-4174
V1 (OPT 325)	5083-4176	1	CRT, P31 ALUMINIZED INTERNAL GRATICULE	28480	5083-4176
W1	01332-61604	1	CABLE ASSY, INPUT Y (OPTION 106-2 REQ'D)	28480	01332-61604
W2	01332-61601	1	CABLE ASSY, Y OUTPUT	28480	01332-61601
W3	01332-61603	1	CABLE ASSY, INPUT X (OPTION 106-2 REQ'D)	28480	01332-61603
W4	01332-61602	1	CABLE ASSY, X OUTPUT	28480	01332-61602
W5	01332-61605	1	CABLE ASSY, INPUT Z (OPTION 206-2 REQ'D)	28480	01332-61605
W6	8120-1521	1	CABLE, UNSHLF 3-CON 18 AWG (AC INPUT)	28480	8120-1521
W7	01334-61601	1	CABLE ASSY, CRT	28480	01334-61601
W8 (OPT 324)	01332-61614	1	CABLE ASSY, REMOTE INPUT	28480	01332-61614
W9 (OPT 216)	01332-61608	1	CABLE ASSY, LOGIC BLANKING	28480	01332-61608
XF1	1400-0084	1	FUSEHOLDER; EXTR POST BAY CAP 15A	28480	1400-0084
XQ1	01332-61102	3	CONN AND CABLE, TSTR	28480	01332-61102
XQ2	01332-61102		CONN AND CABLE, TSTR	28480	01332-61102
XQ3	01332-61102		CONN AND CABLE, TSTR	28480	01332-61102
XQ4	01332-61101	1	CONN AND CABLE, TSTR	28480	01332-61101
			A1 PARTS		
A1	01332-66509	1	BOARD ASSY, MAIN	28480	01332-66509
A1C1	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A1C1 (OPT 200, 201)	0121-0451		CAPACITOR, VAR, TRMR, AIR 1.7/11 PF	74970	187-0106-005
A1C2	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A1C2 (OPT 200, 201)	0121-0451		CAPACITOR, VAR, TRMR, AIR 1.7/11 PF	74970	187-0106-005
A1C3 (OPT 200, 201)	0160-2198		CAPACITOR-FXD 20PF +–5% 300WVDC	02367	OBD
A1C4 (OPT 200, 201)	0160-2198		CAPACITOR-FXD 20PF +–5% 300WVDC	02367	OBD
A1C5	0160-3451	57	CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A1C6	0160-3451		CAPACITOR-FXD .01UF +80–20% 100WVDC	28480	0160-3451
A1C7	0160-2308	3	CAPACITOR-FXD 36PF +–5% 300WVDC	28480	0160-2308
A1C8	0121-0474	9	CAPACITOR; VAR; TRMR; PSTN; .3/1.5PF	28480	0121-0474
A1C9	0160-3665		CAPACITOR-FXD .01UF +80–20% 500WVDC	01688	DD62-3B305Z5103Z500V
A1C10	0160-3665		CAPACITOR-FXD .01UF +80–20% 500WVDC	01688	DD62-3B305Z5103Z500V
A1C11	0160-3670		CAPACITOR-FXD .1UF –20% 200WVDC	02813	CY30B104M

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A1 PARTS (CONT'D)		
A1C13	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC	28480	0160-3451
A1C14	0180-0470	2	CAPACITOR-FXD 1100UF +100−10% 40VDC AL	90201	20-36238
A1C15	0160-3448	3	CAPACITOR-FXD .001UF +−10% 1000WVDC	01688	DD61108305X5E102K1KV
A1C16	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC	28480	0160-3451
A1C17	0180-0470		CAPACITOR-FXD 1100UF +100−10% 40VDC AL	90201	20-36238
A1C18	0160-3448		CAPACITOR-FXD .001UF +−10% 1000WVDC	01688	DD61108305X5E102K1KV
A1C19	0160-3665	10	CAPACITOR-FXD .01UF +80−20% 500WVDC	28480	0160-3665
A1C20	0180-0471	1	CAPACITOR-FXD 200UF +75−10% 200VDC AL	28480	0180-0471
A1C21	0160-3448		CAPACITOR-FXD .001UF +−10% 1000WVDC	01688	DD61108305X5E102K1KV
A1C22	0180-0141	1	CAPACITOR-FXD 50UF +75−10% 50VDC AL	56289	30D506G050DD2
A1C23	0160-0164	1	CAPACITOR-FXD .039UF +−10% 200WVDC	56289	292P39392
A1C24	0160-3558	1	CAPACITOR-FXD .1UF +80−20% 25WVDC	28480	0160-3558
A1C25	0180-0269	1	CAPACITOR-FXD 1UF +75−10% 150VDC AL	56289	30D105G15CBA2
A1C26	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC	28480	0160-3451
A1C27	0180-1746	10	CAPACITOR-FXD 15UF +−10% 20VDC TA-SOLID	56289	150D156X902082
A1C28	0160-3665		CAPACITOR-FXD .01UF +80−20% 500WVDC	28480	0160-3665
A1C29	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC	28480	0160-3451
A1C30	0180-1746		CAPACITOR-FXD 15UF +−10% 20VDC TA	56289	150D225X902CB2
A1C31	0180-0197	2	CAPACITOR-FXD 2.2UF +−10% 20VDC TA	56289	150D225X9020A2
A1C32	0180-0197		CAPACITOR-FXD 2.2UF +−10% 20VDC TA	56289	150D225X9020A2
A1C33	0160-0166	1	CAPACITOR-FXD .068UF +80−20% 200WVDC	28480	0160-0166
A1C34	0160-3451		CAPACITOR-FXD .01UF +80−20% 100WVDC	28480	0160-3451
A1C35	0160-3449	1	CAPACITOR-FXD .002UF +−10% 250WVDC	28480	0160-3449
A1C36	0160-3670		CAPACITOR-FXD 0.1UF +−20% 200WVDC	72982	8131-M200-651-104M
A1C37	0160-3670		CAPACITOR-FXD 0.1UF +−20% 200WVDC	72982	8131-M200-651-104M
A1C38	0160-3670		CAPACITOR-FXD 0.1UF +−20% 200WVDC	72982	8131-M200-651-104M
A1C151 (OPT 325)	0180-1780	1	CAPACITOR-FXD 500UF +75−10% 10VDC TA-SOLID	28480	0180-1780
A1CR1	1901-0376	10	DIODE-GEN PRP 35V 50MA	28480	1901-0376
A1CR2	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A1CR3	1901-0040	13	DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR5 (OPT 215)	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A1CR6			NOT ASSIGNED		
A1CR7			NOT ASSIGNED		
A1CR8	1901-0028	18	DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR9	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR10	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR11	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR12	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR13	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR14	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR15	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR16	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR17	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR18	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR19	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR20	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR21			NOT ASSIGNED		
A1CR22	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR23	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR24	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR25	1901-0045	1	DIODE-PWR RECT 100V 750MA	28480	1901-0045
A1CR26 (OPT 216)	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR27	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR28	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1CR29	1901-0096		DIODE-SWITCHING 100NS 120V 50MA	28480	1901-0096
A1CR30	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR31	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1CR151 (OPT 325)	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A1E1	2110-0269	8	FUSEHOLDER	02603	08D
A1F1	2110-0004	3	FUSE .25A 250V	71400	AGC-1/4
A1F2	2110-0004		FUSE .25A 250V	71400	AGC-1/4
A1F3	2110-0004		FUSE .25A 250V	71400	AGC-1/4
A1F4	2110-0007	1	FUSE 1A 250V SLO-BLO	71400	MDL-1
A1L1	9140-0171	1	COIL, FXD, MOLDED RF CHOKE, 40UH 10%	06560	10608-1
A1L2	9100-1641	1	COIL, FXD, MOLDED RF CHOKE, 240UH 5%	24226	15/243
A1MP1	1205-0231	1	HEAT SINK TO-5/TO-39PKG	02608	2209-4A
A1MP2	1205-0050	9	HEAT SINK TO-5/TO-39PKG	05518	9017-1G1
A1MP3	1205-0030	9	THERMAL LINK TO-5/TO-39PKG	05792	TX8E032-031B
A1MP4			NOT ASSIGNED		
A1Q1	1855-0262		TRANSISTOR; FET; DUAL	28480	1855-0262
A1Q2	1853-0036	29	TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q3	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q4	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q5	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q6	1854-0215	21	TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q7	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A1 PARTS (CONT'D)		
A1Q8	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q9	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q10	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A1Q11	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A1Q12	1853-0232	9	TRANSISTOR PNP SI CHIP TO-39 PD-1W	28480	1853-0232
A1Q13	1854-0419	5	TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
A1Q14	1854-0234	1	TRANSISTOR NPN 2N3440 SI PD=1W	02735	2N3440
A1R1	0757-0344		RESISTOR 1M 1% .25WF TUBULAR	24546	C5-1/4-TO-1004-F
A1R1 (OPT 210)	0698-7648		RESISTOR 50 OHMS 1% .25W MO	24546	C-5
A1R1 (OPT 211)	0757-0710		RESISTOR 75 OHMS 1% .25WF TUBULAR	24546	C5-1/4-TO-75RO-F
A1R2	0757-0344		RESISTOR 1M 1% .25WF	24546	C5-1/4-TO-1004-F
A1R2 (OPT 210)	0698-7648		RESISTOR 50 OHMS 1% .25W MO	24546	C-5
A1R2 (OPT 211)	0757-0710		RESISTOR 75 OHMS 1% .25WF	24546	C5-1/4-TO-75RO-F
A1R3	0757-0342		RESISTOR 100K 1% .25WF TUBULAR	24546	C5-1/4-TO-1003-F
A1R3 (OPT 200)	0698-6654		RESISTOR 800K 1% .25WF TUBULAR	19701	MF4C1/8-TO-8003-F
A1R3 (OPT 201)	0698-6400		RESISTOR 900K 1% .25WF TUBULAR	19701	MF52C1/4-TO-9003-F
A1R4	0757-0342		RESISTOR 100K 1% .25WF	24546	C5-1/4-TO-1003-F
A1R4 (OPT 200)	0698-6654		RESISTOR 800K 1% .25WF TUBULAR	19701	MF4C1/8-TO-8003-F
A1R4 (OPT 201)	0698-6400		RESISTOR 900K 1% .25WF TUBULAR	19701	MF52C1/4-TO-9003-F
A1R5 (OPT 200)	0757-0782		RESISTOR 200K 1% .25WF TUBULAR	24546	C5-1/4-TO-2003-F
A1R5 (OPT 201)	0757-0342		RESISTOR 100K 1% .25WF TUBULAR	24546	C5-1/4-TO-1003-F
A1R6 (OPT 200)	0757-0782		RESISTOR 200K 1% .25WF TUBULAR	24546	C5-1/4-TO-2003-F
A1R6 (OPT 201)	0757-0342		RESISTOR 100K 1% .25WF TUBULAR	24546	C5-1/4-TO-1003-F
A1R7	0684-3901	11	RESISTOR 39 OHM 10% .25W CC TUBULAR	01121	CB3901
A1R8	0684-3901		RESISTOR 39 OHM 10% .25W CC TUBULAR	01121	CB3901
A1R9	0757-0290	10	RESISTOR 6.19K 1% .125W F TUBULAR	30983	MF4C1/8-TO-6191-F
A1R10	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	30983	MF4C1/8-TO-6191-F
A1R11	2100-3252	2	RESISTOR; VAR; TRMR; 5K OHM 10% C	32997	3389P-1-502
A1R12	0757-0420	1	RESISTOR 750 OHM 1% .125W	28480	0757-0420
A1R13	0757-0442	20	RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A1R14	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A1R15	0757-0767	9	RESISTOR 43.2K 1% .25W F TUBULAR	24546	C5-1/4-TO-4322-F
A1R16	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	30983	MF4C-1/8-TO-6191-F
A1R17	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	30983	MF4C-1/8-TO-6191-F
A1R18	0757-0283	21	RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A1R19	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A1R20	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A1R21	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A1R22	0698-3155	5	RESISTOR 4.64K 1% .125W F TUBULAR	16299	C4-1/8-TO-4641-F
A1R23	0757-0427	6	RESISTOR 1.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-1501-F
A1R24	0698-0083	6	RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A1R25	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-TO-1961-F
A1R26	0757-0418		RESISTOR 619 OHMS 1% .125W (NOT SUPPLIED WITH A1 ASSEMBLY. ORDER LINEAR AMPLIFIER KIT AT END OF THIS LIST.)	28480	0757-0418
A1R26 (OPT 215)	0757-0424		RESISTOR 1.1K 1% .125WF TUBULAR	24546	C4-1/8-TO-1101-F
A1R27	0757-0457		RESISTOR 47.5K 1% .125WF TUBULAR	24546	C4-1/8-TO-4752-F
A1R28 (OPT 215)	0757-0422		RESISTOR 909 OHMS 1% .125WF	01607	CC
A1R29			NOT ASSIGNED		
A1R30			NOT ASSIGNED		
A1R31	0757-0444		RESISTOR 12.1K 1% .125WF TUBULAR	24546	C4-1/8-TO-1212-F
A1R32	0684-3901		RESISTOR 39 OHM 10% .25W CC TUBULAR (NOT SUPPLIED WITH A1 ASSEMBLY. ORDER NO TTL KIT AT END OF THIS LIST.)	01121	CB3901
A1R33	0757-0430		RESISTOR 2.21K 1% .125W F TUBULAR	24546	C4-1/8-TO-2211-F
A1R34	2100-3252		RESISTOR; VAR; TRMR 5K OHM 10% C	32997	3389P-1-502
A1R35	0757-0434	5	RESISTOR 3.65K 1% .125W F TUBULAR	24546	C4-1/8-TO-3651-F
A1R36	0757-0839	5	RESISTOR 10K 1% .5W F TUBULAR	30983	MF7C1/2-GO-1002-F
A1R37	0757-0846	5	RESISTOR 22.1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-2212-F
A1R38	0757-0281	5	RESISTOR 2.74K 1% .125W F TUBULAR	24546	C4-1/8-TO-2741-F
A1R39	0684-1001	39	RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A1R40	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A1R41	0757-0730	5	RESISTOR 750 OHM 1% .25W F TUBULAR	24546	C5-1/4-TO-751-F
A1R42			NOT ASSIGNED		
A1R43	0687-3921	2	RESISTOR 3.9K 10% .5W CC TUBULAR	01121	EB3921
A1R44	0757-0435	6	RESISTOR 3.92K 1% .125W F TUBULAR	24546	C4-1/8-TO-3921-F
A1R45	0757-0418	2	RESISTOR 619 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-619R-F
A1R46	0757-0446	2	RESISTOR 15K 1% .125W F TUBULAR	24546	C4-1/8-TO-1502-F
A1R47	0699-0003	2	RESISTOR 8.2 OHM 10% .5W CC TUBULAR	01121	EB82G1
A1R48	0757-0440	2	RESISTOR 7.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-7501-F
A1R49	0757-0441	3	RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-TO-8251-F
A1R50	0687-3921		RESISTOR 3.9K 10% .5W CC TUBULAR	01121	EB3921
A1R51	0757-0435		RESISTOR 3.92K 1% .125W F TUBULAR	24546	C4-1/8-TO-3921-F
A1R52	0757-0280	4	RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A1R53	0757-0446		RESISTOR 15K 1% .125W F TUBULAR	24546	C4-1/8-TO-1502-F
A1R54	0699-0003		RESISTOR 8.2 OHM 10% .5W CC TUBULAR	01121	EB82G1
A1R55	0757-0440		RESISTOR 7.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-7501-F
A1R56	0757-0441		RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-TO-8251-F
A1R57	0687-1041	1	RESISTOR 100K 10% .5W CC TUBULAR	01121	EB1041
A1R58	0764-0005	1	RESISTOR 10K 5% 2W MO TUBULAR	24546	FP42-2-TOO-1002-J

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A1 PARTS (CONT'D)		
A1R59	0757-1093	3	RESISTOR 3K 1% .125W F TUBULAR	24546	C4-1/8-TO-3001-F
A1R60	0757-1093		RESISTOR 3K 1% .125W F TUBULAR	24546	C4-1/8-TO-3001-F
A1R61	0698-3152	1	RESISTOR 3.48K 1% .125W F TUBULAR	16299	C4-1/8-TO-3481-F
A1R62	0757-0342	14	RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-TO-1003-F
A1R63	0757-0418		RESISTOR 619 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-619R-F
A1R64	0757-1093		RESISTOR 3K 1% .125W F TUBULAR	24546	C4-1/8-TO-3001-F
A1R65	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-TO-1003-F
A1R66	0686-3005	1	RESISTOR 30 OHM 5% .5W CC TUBULAR	01121	EB3005
A1R67	0757-0485	1	RESISTOR 681K 1% .125W F TUBULAR	19701	MFF-1/8, T-1
A1R68	0757-0465	2	RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-TO-1003-F
A1R69	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-TO-1003-F
A1R70	0684-1211	1	RESISTOR 120 OHM 10% .25W CC TUBULAR	01121	CB1211
A1R71	0683-2265	1	RESISTOR 22M 5% .25W CC TUBULAR	01121	CB2265
A1R72	0684-3941	1	RESISTOR 390K 10% .25W CC TUBULAR	01121	CB3941
A1R73	0687-3911	1	RESISTOR 390 OHM 10% .5W CC TUBULAR	01121	EB3911
A1R74	0684-1021	5	RESISTOR 1K 10% .25W CC TUBULAR	01121	CB1021
A1R75	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A1R76	2100-3253	2	RESISTOR; VAR; TRMR; 50K OHM 10% C	32997	3389P-1-503
A1R77	2100-0558	1	RESISTOR; VAR; TRMR; 20K OHM 10% C	73138	72P
A1R78	0757-0461	1	RESISTOR 24.3K 1% .125W F TUBULAR	24546	C4-1/8-TO-2432-F
A1R79	2100-3253		RESISTOR; VAR; TRMR; 50K OHM 10% C	32997	3389P-1-503
A1R80	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A1R81	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A1R82	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A1R83	0684-1011	1	RESISTOR 100 OHM 10% .25W CC TUBULAR	01121	CB1011
A1R84	2100-3213		RESISTOR 200K OHM 10% .5W CM TUBULAR	28480	2100-3213
A1R85 (OPT 216)	0684-2231		RESISTOR 22K 10% .25W CC TUBULAR	01121	CB2231
A1R86 (OPT 216)	0757-0454		RESISTOR 33.2K 1% .125W F TUBULAR	01607	CC
A1R87 (OPT 216)	0757-0441		RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-TO-8251-F
A1R88 THRU A1R149			NOT ASSIGNED		
A1R150	0684-2221		RESISTOR 2.2K OHM 10% .25W CC	01121	CB2221
A1R151 (OPT 325)	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A1R152 (OPT 325)	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A1R153	0683-0475		NOT ASSIGNED		
A1R154 (OPT 325)	2100-3253		RESISTOR; VAR; TRMR; 50K OHM 10% C TOP ADJ	73138	72PR50K
A1R155 (OPT 325)	0684-2221		RESISTOR 2.2K OHM 10% .25W CC	01121	CB2221
A1U1	1820-0196	3	IC; LIN; VOLTAGE REGULATOR	07263	723HC
A1U2	1820-0196		IC; LIN; VOLTAGE REGULATOR	07263	723HC
A1U3	1820-0196		IC; LIN; VOLTAGE REGULATOR	07263	723HC
A1U4	1826-0167	1	IC; LIN; MISCELLANEOUS (LINEAR)	02735	CA3094AT
A1VR1	1902-3104	5	DIODE-ZNR 5.62V 5% DO-7 PD=.4W	04713	SZ 10939-110
A1VR2	1902-0049	1	DIODE-ZNR 6.19V 5% DO-7 PD=.4W	28480	1902-0049
A1VR3	1902-3354	1	DIODE-ZNR 54.9V 5% DO-7 PD=.4W	04713	SZ 10939-396
A1VR4	1902-3357	2	DIODE-ZNR 56.2V 5% DO-7 PD=.4W	04713	SZ 10939-398
A1VR5	1902-0594		DIODE-ZNR 18.2V VZ 1W MAX PD	04713	SZ 11213-215
A1VR6	1902-3357		DIODE-ZNR 56.2V 5% DO-7 PD=.4W	04713	SZ 10939-398
A1VR7	1902-0594	1	DIODE-ZNR 18.2V VZ; 1W MAX PD	04713	SZ 11213-215
A1VR8	1902-3193	1	DIODE-ZNR 13.3V 5% DO-7 PD=.4W	04713	SZ 10939-218
A1VR9	1902-3070		DIODE-ZNR 4.22V 5% DO-7 PD=.4W	15818	CD35598
A1VR10	1902-0038	1	DIODE-ZNR 45.3V 5% DO-7 PD=.4W	04713	SZ 10939-371
A1XA2P1	1251-1631		CONNECTOR: EDGE 10-CONT IRON	04507	252-10-30-310
A1XA2P2	1251-1631		CONNECTOR: EDGE 10-CONT IRON	04507	252-10-30-310
A1XA3	1251-1631		CONNECTOR: EDGE 10-CONT IRON	04507	252-10-30-310
			A1 MISCELLANEOUS PARTS		
	0360-1653	3	TERMINAL; SLDR STUD	28480	0360-1653
	0360-1788	31	TERMINAL; SLDR STUD; .045 SHK DIA	28480	0360-1788
			KIT, STANDARD, LINEAR AMPLIFIER		
A1	01332-88717	1	KIT, STANDARD, LINEAR AMPLIFIER	28480	01332-88717
A1R26	0757-0418	1	RESISTOR 619 OHMS 1% .125W	28480	0757-0418
			KIT, STANDARD, NO TTL		
A1	01332-88712	1	KIT, STANDARD, NO TTL	28480	01332-88712
A1R32	0684-3901		RESISTOR 39 OHM 10% .25W CC TUBULAR	01121	CB3901
			A2 PARTS		
A2	01335-66512	1	BOARD ASSY, X-Y	28480	01335-66512
A2C1	0160-3451		CAPACITOR-FXD .01UF +80—20% 100WVDC (NOT SUPPLIED WITH A2 ASSEMBLY. ORDER STANDARD DEFLECTION KIT AT END OF THIS LIST.)	28480	0160-3451
A2C1 (OPT 100, 101)	0121-0455		CAPACITOR-VAR TRMR AIR 1.9/15.7 PF	74970	187-0109-005
A2C2	0160-3451		CAPACITOR-FXD .01UF +80—20% 100WVDC (NOT SUPPLIED WITH A2 ASSEMBLY. ORDER STANDARD DEFLECTION KIT AT END OF THIS LIST.)	28480	0160-3451

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A2 PARTS (CONT'D)		
A2C2 (OPT 100, 101)	0121-0455		CAPACITOR-VAR TRMR AIR 1.9/15.7 PF	74970	187-0109-005
A2C3 (OPT 100, 101)	0160-2200		CAPACITOR-FXD 43PF +-5% 300WVDC	28480	0160-2200
A2C4 (OPT 100, 101)	0160-2200		CAPACITOR-FXD 43PF +-5% 300WVDC	28480	0160-2200
A2C5	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C6	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C7 (OPT 121)	0140-0218		CAPACITOR-FXD 160PF +-2% 300WVDC	72136	DM15F161G0300WV1CR
A2C8 (OPT 121)	0140-0218		CAPACITOR-FXD 160PF +-2% 300WVDC	72136	DM15F161G0300WV1CR
A2C9	0140-0198	2	CAPACITOR-FXD 200PF +-5% 300WVDC	72136	DM15F201J0300WV1CR
A2C10	0121-0474		CAPACITOR; VAR; TRMR; PSTN; .3/1.5PF	28480	0121-0474
A2C11	0121-0474		CAPACITOR; VAR; TRMR; PSTN; .3/1.5PF	28480	0121-0474
A2C12	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C13	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C14	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C15	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C16	0160-3670		CAPACITOR-FXD .1UF +80-20% 200WVDC	28480	0160-3670
A2C17	0160-3670		CAPACITOR-FXD .1UF +80-20% 200WVDC	28480	0160-3670
A2C18	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC (NOT SUPPLIED WITH A2 ASSEMBLY. ORDER STANDARD DEFLECTION KIT AT END OF THIS LIST.)	28480	0160-3451
A2C18 (OPT 100, 101)	0121-0455		CAPACITOR-VAR TRMR AIR 1.9/15.7PF	74970	187-0109-005
A2C19	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC (NOT SUPPLIED WITH A2 ASSEMBLY. ORDER STANDARD DEFLECTION KIT AT END OF THIS LIST.)	28480	0160-3451
A2C19 (OPT 100, 101)	0121-0455		CAPACITOR-VAR TRMR AIR 1.9/15.7PF	74970	187-0109-005
A2C20 (OPT 100, 101)	0160-2200		CAPACITOR-FXD 43PF +-5% 300WVDC	28480	0160-2200
A2C21 (OPT 100, 101)	0160-2200		CAPACITOR-FXD 43PF +-5% 300WVDC	28480	0160-2200
A2C22	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C23	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C24 (OPT 121)	0140-0218		CAPACITOR-FXD 160PF +-2% 300WVDC	72136	DM15F161G0300WV1CR
A2C25 (OPT 121)	0140-0218		CAPACITOR-FXD 160PF +-2%	72136	DM15F161G0300WV1CR
A2C26	0140-0198		CAPACITOR-FXD 200PF +-5% 300WVDC	72136	DM15F201J0300WV1CR
A2C27	0121-0474		CAPACITOR; VAR; TRMR; PSTN; .25/1.5PF	28480	0121-0474
A2C28	0121-0474		CAPACITOR; VAR; TRMR; PSTN; .25/1.5PF	28480	0121-0474
A2C29	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C30	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C31	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C32	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C33	0160-3670		CAPACITOR-FXD .1UF +80-20% 200WVDC	28480	0160-3670
A2C34	0160-3670		CAPACITOR-FXD .1UF +80-20% 200WVDC	28480	0160-3670
A2C36	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C37	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C38	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C39	0180-1746		CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C40	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C42	0180-1746		CAPACITOR-FXD; 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C43	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C44	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C45	0160-3665		CAPACITOR-FXD .01UF +80-20% 500WVDC CER	28480	0160-3665
A2C47	0180-1746		CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C48	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C49	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C50	0180-1746		CAPACITOR-FXD 15UF +-10% 20VDC TA-SOLID	56289	150D156X9020B2
A2C51	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2CR1	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2CR2	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2CR3	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR5	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2CR6	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2CR7	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2CR8	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2MP1	1205-0213		HEAT-DISSIPATOR; SGL; TO-5 PKG	02680	2228B
A2MP2	1205-0226		HEAT-DISSIPATOR; SGL; TO-5 PKG	02680	1115B
A2MP3	1200-0185	16	INSULATOR: XSTR; TO-5, .075 THK	13103	7717-22-N RED
A2MP4	1600-0441	2	SHIELD, AMPLIFIER	28480	1600-0441
A2MP5	01332-01203	2	BRACKET-X GAIN	28480	01332-01203
A2MP6	01332-01204	2	BRACKET-Y GAIN	28480	01332-01204
A2MP7	01332-01205	2	BRACKET-TA & AST	28480	01332-01205
A2Q1	1855-0262		TRANSISTOR; FET; DUAL	28480	1855-0262
A2Q2	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q3	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q4	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q5	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A2 PARTS (CONT'D)		
A2Q6	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q7	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q8	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q9	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q10	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q11	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q12	1853-0232		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0232
A2Q13	1854-0523	4	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A2Q14	1854-0523		TRANSISTOR NPN SI TO-35 PD=1W FT=150MHZ	28480	1854-0523
A2Q15	1853-0232		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0232
A2Q16	1855-0262		TRANSISTOR; FET; DUAL	28480	1855-0262
A2Q17	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q18	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q19	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q20	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q21	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q22	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q23	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q24	1853-0036		TRANSISTOR NPN SI CHIP PD=310MW	28480	1853-0036
A2Q25	1853-0036		TRANSISTOR PNP SI CHIP PD=310MW	28480	1853-0036
A2Q26	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2Q27	1853-0232		TRANSISTOR PNP SI CHIP TO-39 PD=1W	28480	1853-0232
A2Q28	1854-0523		TRANSISTOR NPN SI TO-39 PF=1W FT=150MHZ	28480	1854-0523
A2Q29	1854-0523		TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A2Q30	1853-0232		TRANSISTOR PNP SI CHIP TO-39 PF=1W	28480	1853-0232
A2R1	0757-0344		RESISTOR 1M 1% .25WF TUBULAR (NOT SUPPLIED WITH A2 ASSEMBLY. ORDER STANDARD INPUT X-Y KIT AT END OF THIS LIST.)	24546	C5-1/4-TO-1004-F
A2R1 (OPT 110)	0698-7648		RESISTOR 50 OHM 1% .25W MO	24546	C-5
A2R2	0757-0344		RESISTOR 1M 1% .25WF TUBULAR (NOT SUPPLIED WITH A2 ASSEMBLY. ORDER STANDARD INPUT X-Y KIT AT END OF THIS LIST.)	24546	C5-1/4-TO-1004-F
A2R2 (OPT 110)	0698-7648		RESISTOR 50 OHM 1% .25W MO	24546	C-5
A2R3	0757-0342		RESISTOR 100K 1% .25WF TUBULAR (NOT SUPPLIED WITH A2 ASSEMBLY. ORDER STANDARD DEFLECTION KIT AT END OF THIS LIST.)	24546	C5-1/4-TO-1003-F
A2R3 (OPT 100)	0698-6654		RESISTOR 800K 1% .25WF TUBULAR	19701	MF4C1/8-TO-8003-F
A2R3 (OPT 101)	0698-6400		RESISTOR 900K 1% .25WF TUBULAR	19701	MF52C1/4-TO-9003-F
A2R4	0757-0342		RESISTOR 100K 1% .25WF TUBULAR (NOT SUPPLIED WITH A2 ASSEMBLY. ORDER STANDARD DEFLECTION KIT AT END OF THIS LIST.)	24546	C5-1/4-TO-1003-F
A2R4 (OPT 100)	0698-6654		RESISTOR 800K 1% .25WF TUBULAR	19701	MF4C1/8-TO-8003-F
A2R4 (OPT 101)	0698-6400		RESISTOR 900K 1% .25WF TUBULAR	19701	MF52C1/4-TO-9003-F
A2R5 (OPT 100)	0757-0782		RESISTOR 200K 1% .25WF TUBULAR	24546	C5-1/4-TO-2003-F
A2R5 (OPT 101)	0757-0342		RESISTOR 100K 1% .25WF TUBULAR	24546	C5-1/4-TO-1003-F
A2R6 (OPT 100)	0757-0782		RESISTOR 200K 1% .25WF TUBULAR	24546	C5-1/4-TO-2003-F
A2R6 (OPT 101)	0757-0342		RESISTOR 100K 1% .25WF TUBULAR	24546	C5-1/4-TO-1003-F
A2R7	0684-3901		RESISTOR 39 OHM 10% .25W CC TUBULAR	01121	CB3901
A2R8	0684-3901		RESISTOR 39 OHM 10% .25W CC TUBULAR	01121	CB3901
A2R9	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	30983	MF4C1/8-TO-6191-F
A2R10	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	30983	MF4C1/8-TO-6191-F
A2R11	2100-0646	4	RESISTOR; VAR; CONT; 5K 10% CC	01121	70M4N056R502U
A2R12	0757-0424		RESISTOR 1.1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1101-F
A2R13	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A2R14	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A2R15	0757-0851	6	RESISTOR 43.2K 1% .5W F TC=0+-100	19701	MF7C1/2-TO-4322-F
A2R16	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A2R17	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A2R18	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A2R19	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A2R20	0698-3155		RESISTOR 4.64K 1% .125W F TUBULAR	16299	C4-1/8-TO-4641-F
A2R21	0757-0427		RESISTOR 1.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-1501-F
A2R22	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A2R23	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A2R24	2100-3211	8	RESISTOR; VAR; TRMR; 1K OHM 10% C	32997	3389P-1-102
A2R25	0757-0419	4	RESISTOR 681 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-681R-F
A2R26	0757-0435		RESISTOR 3.92K 1% .125W F TUBULAR	24546	C4-1/8-TO-3921-F
A2R27	0757-0435		RESISTOR 3.92K 1% .125W F TUBULAR	24546	C4-1/8-TO-3921-F
A2R28	0757-0460	4	RESISTOR 61.9K 1% .125W F TUBULAR	24546	C4-1/8-TO-6192-F
A2R29	0757-0460		RESISTOR 61.9K 1% .125W F TUBULAR	24546	C4-1/8-TO-6192-F
A2R30	2100-3211		RESISTOR; VAR; TRMR; 1K OHM 10% C	32997	3389P-1-102
A2R31	0761-0004	4	RESISTOR 20K 5% 1W MO TC=0+-200	24546	FP32-1-2002-J
A2R32	0761-0004		RESISTOR 20K 5% 1W MO TC=0+-200	24546	FP32-1-2002-J
A2R33	0684-6821	4	RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A2R34	0684-6821		RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A2R35	0757-0851		RESISTOR 43.2K 1% .5W F TC=0+-100	19701	MF7C1/2-TO-4322-F
A2R36	0757-0851		RESISTOR 43.2K 1% .5W F TC=0+-100	19701	MF7C1/2-TO-4322-F
A2R37	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R38	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R39	0698-7096	8	RESISTOR 10 OHM 10% .125W CC TUBULAR	01121	BB1001
A2R40	0698-7096		RESISTOR 10 OHM 10% .125W CC TUBULAR	01121	BB1001
A2R41	0757-0438	4	RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A2R42	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A2 PARTS (CONT'D)		
A2R43	0757-0736	4	RESISTOR 1.5K 1% .25W F TUBULAR	24546	C5-1/4-TO-1501-F
A2R44	0757-0736		RESISTOR 1.5K 1% .25W F TUBULAR	24546	C5-1/4-TO-1501-F
A2R51	0684-3901		RESISTOR 39 OHM 10% .25W CC TUBULAR	01121	CB3901
A2R52	0684-3901		RESISTOR 39 OHM 10% .25W CC TUBULAR	01121	CB3901
A2R53	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	30983	MF4C1/8-TO-6191-F
A2R54	0757-0290		RESISTOR 6.19K 1% .125W F TUBULAR	30983	MF4C1/8-TO-6191-F
A2R55	2100-0646		RESISTOR; VAR; 5K 10% LIN CCP	01607	73M4N056L502U
A2R56	0757-0424		RESISTOR 1.1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1101-F
A2R57	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A2R58	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A2R59	0757-0851		RESISTOR 43.2K 1% .5W F TC=0+-100	19701	MF7C1/2-TO-4322-F
A2R60	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A2R61	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-TO-1002-F
A2R62	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A2R63	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A2R64	0698-3155		RESISTOR 4.64K 1% .125W F TUBULAR	16299	C4-1/8-TO-4641-F
A2R65	0757-0427		RESISTOR 1.5K 1% .125W F TUBULAR	24546	C4-1/8-TO-1501-F
A2R66	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A2R67	0757-0283		RESISTOR 2K 1% .125W F TUBULAR	24546	C4-1/8-TO-2001-F
A2R68	2100-3211		RESISTOR; VAR; TRMR; 1K OHM 10% C	32997	3389P-1-102
A2R69	0757-0419		RESISTOR 681 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-681R-F
A2R70	0757-0435		RESISTOR 3.92K 1% .125W F TUBULAR	24546	C4-1/8-TO-3921-F
A2R71	0757-0435		RESISTOR 3.92K 1% .125W F TUBULAR	24546	C4-1/8-TO-3921-F
A2R72	0757-0460		RESISTOR 61.9K 1% .125W F TUBULAR	24546	C4-1/8-TO-6192-F
A2R73	0757-0460		RESISTOR 61.9K 1% .125W F TUBULAR	24546	C4-1/8-TO-6192-F
A2R74	2100-3211		RESISTOR; VAR; TRMR; 1K OHM 10% C	32997	3389P-1-102
A2R75	0761-0004		RESISTOR 20K 5% 1W MO TC=0+-200	24546	FP32-1-2002-J
A2R76	0761-0004		RESISTOR 20K 5% 1W MO TC=0+-200	24546	FP32-1-2002-J
A2R77	0684-6821		RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A2R78	0684-6821		RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A2R79	0757-0851		RESISTOR 43.2K 1% .5W F TC=0+-100	19701	MF7C1/2-TO-4322-F
A2R80	0757-0851		RESISTOR 43.2K 1% .5W F TC=0+-100	19701	MF7C1/2-TO-4322-F
A2R81	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R82	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R83	0698-7096		RESISTOR 10 OHM 10% .125W CC TUBULAR	01121	BB1001
A2R84	0698-7096		RESISTOR 10 OHM 10% .125W CC TUBULAR	01121	BB1001
A2R85	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A2R86	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-TO-5111-F
A2R87	0757-0736		RESISTOR 1.5K 1% .25W F TUBULAR	24546	C5-1/4-TO-1501-F
A2R88	0757-0736		RESISTOR 1.5K 1% .25W F TUBULAR	24546	C5-1/4-TO-1501-F
A2R89	2100-0646	4	RESISTOR; VAR; 5K LIN CCP	01607	70M4N056R502U
A2R90	2100-0645		RESISTOR; VAR; CONT; 50K 10% CC	01121	70M4N056R503U
A2R91	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R92	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R93	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R94	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R95	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R96	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R97	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R98	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R99	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R100	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R101	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R102	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2R103	0684-1001		RESISTOR 10 OHM 10% .25W CC TUBULAR	01121	CB1001
A2VR1	1902-3104		DIODE-ZNR 5.62V 5% DO-7 PD=.4W	04713	SZ 10939-110
A2VR2	1902-3104		DIODE-ZNR 5.62V 5% DO-7 PD=.4W	04713	SZ 10939-110
A2VR3	1902-3070		DIODE-ZNR 4.22V 5% PD=.4W	15818	CD35598
A2VR4	1902-3070		DIODE-ZNR 4.22V 5% PD=.4W	15818	CD35598
			A2 MISCELLANEOUS PARTS		
	0360-1653	20	TERMINAL; SLDR STUD	28480	0360-1653
	2200-0101	3	SCREEN-MACH 4-40 .188 IN. LG. PAN HD POZI	04771	OBD
			KIT, STANDARD DEFLECTION		
A2	01332-88701	1	KIT, STANDARD DEFLECTION	28480	01332-88701
A2C1	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C2	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C18	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2C19	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC	28480	0160-3451
A2R3	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-TO-1003-F
A2R4	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-TO-1003-F
A2R47	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-TO-1003-F
A2R48	0757-0342		RESISTOR 100K 1% .25W F TUBULAR	24546	C5-1/4-TO-1003-F
			KIT, STANDARD INPUT X-Y		
A2	01332-88704	1	KIT, STANDARD INPUT X-Y	28480	01332-88704
A2R1	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-TO-1004-F
A2R2	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-TO-1004-F
A2R45	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-TO-1004-F
A2R46	0757-0344		RESISTOR 1M 1% .25W F TUBULAR	24546	C5-1/4-TO-1004-F

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			A3 PARTS		
A3	01332-66508		BOARD ASSY, HIGH VOLTAGE	28480	01332-66508
A3C1	0160-4148	2	CAPACITOR-FXD .033UF +-20% 6000WVDC	56289	430P333060
A3C2	0160-4148		CAPACITOR-FXD .033UF +-20% 6000WVDC	56289	430P333060
A3C3	0160-3960	2	CAPACITOR-FXD .001UF +-20% 8000WVDC	84411	HEW337
A3C4	0160-2264	1	CAPACITOR-FXD 20PF +-5% 500WVDC	28480	0160-2264
A3C5	0160-3960		CAPACITOR-FXD .001UF +-20% 8000WVDC	84411	HEW337
A3C6	0160-0678	2	CAPACITOR-FXD .01UF +-20% 6000WVDC	84411	HEW337
A3C7	0160-0678		CAPACITOR-FXD .01UF +-20% 6000WVDC	84411	HEW337
A3C8	0160-0543	1	CAPACITOR-FXD .0047UF +-20% 4000WVDC	84411	HEW337
A3CR1	1901-0683	1	DIODE-HV RECT 250NS 10KV 5MA	28480	1901-0683
A3CR2	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A3CR3	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A3CR4	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A3CR5	1901-0028		DIODE-PWR RECT 400V 750MA	04713	SR1358-9
A3J1	1251-0206	1	CONNECTOR; 1-CONT SKT .04DIA; WHT TFE	98291	SKT-400
A3MP1	0340-0007	2	STANDOFF-RND-FEM .5-LG 6-THD .5-OD CER	28480	0340-0007
A3MP2	01332-01201	1	BRACKET, HIGH VOLTAGE BOARD	28480	01332-01201
A3R1	0684-1041	1	RESISTOR 100K 10% .25W CC TUBULAR	01121	CB1041
A3R2	0687-4721	1	RESISTOR 4.7K 10% .5W CC TUBULAR	01121	EB4721
A3R3	0687-3941	1	RESISTOR 390K 10% .5W CC TUBULAR	01121	EB3941
A3R4	0698-8018	1	RESISTOR 30M +1−19% 3W CP TUBULAR	03888	PVC175-3-TO-3004-F
A3R5	0684-1021		RESISTOR 1K 10% .25W CC TUBULAR	01121	CB1021
A3R6	0684-1021		RESISTOR 1K 10% .25W CC TUBULAR	01121	CB1021
A3R7	0684-1061	1	RESISTOR 10M 10% .25W CC	01121	CB1061
A3R8	0684-1021		RESISTOR 1K 10% .25W CC	01121	CB1021
A3R9	0684-1051	1	RESISTOR 1M 10% .25W CC	01121	CB1051
A3R10	0687-2221		RESISTOR 2.2K OHM 10% .5W CC TUBULAR	01121	EB2221
A3R11	0687-1001		RESISTOR 10 OHM 10% .5W CC	01121	EB1001
A3R12	0698-5353	1	RESISTOR 8.25M 5% 1W CF TUBULAR	28480	0698-5353
A3R13	2100-3501	1	RESISTOR; VAR; TRMR; 2M OHM 20% MG	28480	2100-3501
A3R14	0698-6442	1	RESISTOR 13M 5% 1W CF TUBULAR	28480	0698-6442
A3R15	0684-1021		RESISTOR 1K 10% .25W CC TUBULAR	01121	CB1021
A3R16	0687-1011		RESISTOR 100 OHM 10% .5W CC	01121	EB1011
A3T1	01332-61103	1	TRANSFORMER	28480	01332-61103
A3V1	2140-0018		LAMP, GLOW, BULB T-2, 58V	08806	A9A (NE-2E1)
A3V2	2140-0018		LAMP, GLOW, BULB T-2, 58V	08806	A9A (NE-2E1)
A3VR1	1902-0182	1	DIODE-ZNR 20.5V 5% PD=.4W	28480	1902-0182
			A3 MISCELLANEOUS PARTS		
	0360-0535	1	TERMINAL, TEST POINT	4G819	OBD
	0360-1653		TERMINAL, SLDR STUD	28480	0360-1653
	2360-0275	4	SCREW-MACH 6-32 BDG HD SLT REC NYL-BLK	73734	102222
			A4 PARTS		
A4			NOT ASSIGNED		
			A5 PARTS		
A5	01332-66505		BOARD ASSY, CONTROL	28480	01332-66505
A5R1	2100-0649	1	RESISTOR-VAR CONT 20K 10% CC	28480	2100-0649
A5R2	2100-0649		RESISTOR-VAR CONT 20K 10% CC	28480	2100-0649
A5R3	2100-0649		RESISTOR-VAR CONT 20K 10% CC	28480	2100-0649
A5R3 (OPT 322)	2100-3660		RESISTOR-VAR PREC 20K 5% WW 10 TURN	28480	2100-3660
A5R3MP1 (OPT 322)	1140-0066		DIAL, TURNS COUNTING	28480	1140-0066
A5R4	2100-0650		RESISTOR-VAR CONT 2.5M 10% CC	28480	2100-0650
A5R5 (OPT 325)	2100-0648		RESISTOR-VAR CONT 100 OHM 10% C	28480	2100-0648
A5W1	8120-1999		HARNESS, CONTROL BOARD	28480	8120-1999
A6	0960-0383		HIGH VOLTAGE MULTIPLIER ASSY	28480	0960-0383

See introduction to this section for ordering information

Table 6-3. Replaceable Parts for Options (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			OPTION 580		
MP4	1460-1345	2	SPRING WFRM 3-LG SST	28480	1460-1345
MP10	5040-7201	4	FOOT	28480	5040-7201
MP14	5061-1931	1	COVER, TOP	28480	5061-1931
MP15	5061-1922	1	COVER, BOTTOM	28480	5061-1922
			OPTION 604		
V1	5083-4181	1	CRT, P4 ALUMINIZED NO GRATICULE	28480	5083-4181
			OPTION 607		
V1	5083-4131	1	CRT, P7 ALUMINIZED NO GRATICULE	28480	5083-4131
			OPTION 611		
V1	5083-4141	1	CRT, P11 ALUMINIZED NO GRATICULE	28480	5083-4141
			OPTION 631		
V1	5083-4151	1	CRT, P31 ALUMINIZED NO GRATICULE	28480	5083-4151
			OPTION 639		
V1	5083-4170		CRT, P39 ALUMINIZED NO GRATICULE	28480	5083-4170

See introduction to this section for ordering information

Table 6-4. List of Manufacturers' Codes

Mfr No.	Manufacturer Name	Address	Zip Code
00000	U.S.A. COMMON	ANY SUPPLIER OF THE U.S.	
01121	ALLEN BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
01538	SMALL PARTS INC	COSTA MESA CA	92626
02660	AMPHENOL CONNECTOR DIV	BROADVIEW IL	60153
02735	RCA CORP SOLID STATE DIV	SOMMERVILLE NJ	08876
03888	PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
04866	NYLOK-DETROIT CORP	TROY MI	48084
06560	AIRCO SPEER ELECTRONICS DIV OF AIR REDUCTION CO, INC	NOGALES AZ	85621
06915	RICHCO PLASTIC CO	CHICAGO IL	60646
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
08806	GE CO MINIATURE LAMP PROD DEPT	CLEVELAND OH	44112
13103	THERMALLOY CO	DALLAS TX	75247
15818	TELEDYNE SEMICONDUCTOR	MOUNTAIN VIEW CA	94040
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
17856	SILICONIX INC	SANTA CLARA CA	95050
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24226	GOWANDA ELECTRONICS CORP	GOWANDA NY	14070
24546	CORNING GLASS WORKS	BRADFORD PA	16701
24931	SPECIALTY CONNECTOR CO, INC	INDIANAPOLIS IN	46227
24995	ENVIRONMENTAL CONTAINER SYSTEMS INC	PALO ALTO CA	94304
26365	GRIBS REPRODUCTR CORP	NEW ROCHELLE NY	10802
26742	METHODE ELECTRONICS INC	CHICAGO IL	60656
27191	CUTLER-HAMMER INC POWER DISTR CONT	MILWAUKEE WI	53216
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
30983	MEPCO/ELECTRA CORP	SAN DIEGO CA	92121
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
34344	MOTOROLA INC	FRANKLIN PARK IL	60131
4G819	OVERLAND PRODUCTS CO	FREMONT NE	68025
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
57771	STIMPSON EDWIN B CO, INC	BROOKLYN NY	11205
71400	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS MO	63017
71785	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VILLAGE IL	60007
72136	ELECTRO MOTIVE MFG CO, INC	WILLIMANTIC CT	06226
72982	ERIE TECHNOLOGICAL PRODUCTS, INC	ERIE PA	16512
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
73183	FERRY E W SCREW PRODUCTS INC	CLEVELAND OH	44142
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
74970	JOHNSON E F CO	WASECA MN	56093
75915	LITTLEFUSE INC	DES PLAINES IL	60016
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN IL	60126
78452	EVERLOCK CHICAGO INC	CHICAGO IL	60622
82389	HEPWORTH MACHINE CO INC	PORT WASHINGTON NY	11050
84048	TRW INC ST PETERSBURG DIV	ST PETERSBURG FL	33702
84411	TRW CAPACITOR DIV	OGALLALA NE	69153
90201	MALLORY CAPACITOR CO	INDIANAPOLIS IN	46206
91500	ASHEVILLE-SCHOONMAKER MICA CO	NEWPORT NEWS MD	23607
98291	SEALECTRO CORP	MAMARONECK NY	10544

See introduction to this section for ordering information

SECTION VIII

SERVICE

8-1. INTRODUCTION.

8-2. This section provides instructions for troubleshooting and repairing the Model 1332A X-Y Display.

8-3. Principles of operation and troubleshooting information are located opposite the schematics on foldout Service Sheets. This section also provides general service information that should help you to quickly service and repair the X-Y display. DC voltage distribution and adjustment locations are shown on the last foldout page in this section.

8-4. PRINCIPLES OF OPERATION.

8-5. Principles of operation appear on the foldout pages opposite the block diagrams and the schematics on the Service Sheets. Service Sheet 1 is an overall block diagram that briefly describes instrument operation. It is keyed, by numbers in the lower, right-hand corners of the blocks, to the detailed schematics on the Service Sheets that follow. These Service Sheets provide a stage-by-stage description of the circuits on the schematics.

8-6. TROUBLESHOOTING.

WARNING

Read the Safety Summary at the front of this manual before troubleshooting the instrument.

8-7. INITIAL TROUBLESHOOTING PROCEDURE. Before troubleshooting the 1332A in detail, try to perform the adjustment procedures listed in Section V of this manual. Some apparent malfunctions may be corrected by these adjustments, or failure to obtain a correct adjustment will often reveal the source of trouble.

NOTE

Before performing any troubleshooting procedure, eliminate static charge from glass of the CRT faceplate by solidly grounding one hand while rubbing the CRT faceplate with the other hand.

8-8. DC VOLTAGES AND WAVEFORMS. DC voltages, waveforms, and conditions for making these measurements are given on, or adjacent to schematics on the service sheets. Since conditions for making measurements may differ from one circuit to another, always check the specific conditions listed for each schematic.

8-9. RECOMMENDED TEST EQUIPMENT.

8-10. Test equipment required to maintain the 1332A is listed in Section I, table 1-4. Equipment other than that listed may be used if it meets the listed critical specifications.

8-11. PREVENTIVE MAINTENANCE AND REPAIR. Painted surfaces can be cleaned with a commercial, spray-type window cleaner or with a mild soap and water solution.

CAUTION

Do not use chemical cleaning agents that might damage the plastics used in this instrument. Recommended cleaning agents are isopropyl alcohol, kelite (1 part kelite, 20 parts water), or a solution of 1% mild detergent and 99% water.

8-12. Corroded spots are best removed with soap and water. Stubborn residues can be removed with a fine abrasive. Protect such areas from further corrosion with an application of silicone resin such as GE DRIFILM 88.

8-13. CIRCUIT BOARDS.

8-14. Board Connections. Square-pin connectors are identified on circuit boards by color code of connecting wire or by the signal name. Connector pins on plugs and jacks are identified by either a number or a letter. The letters G, I, O, and Q have been omitted. Coaxial wires are identified by different shrink-tubing colors.

8-15. Servicing Etched Circuit Boards. All the etched circuit boards have plated-through component holes. This allows components to be removed or replaced from either side of the board. When unsoldering large components such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information for repair of circuit boards. Figure 8-1 is included to help identify the leads on the common shapes and sizes of semiconductor devices.

Table 8-1. Schematic Notes

REFER TO ANSI Y 32.2 AND Y32.14 FOR SCHEMATIC SYMBOLS NOT LISTED IN THIS TABLE.

ETCHED CIRCUIT BOARD

ASSEMBLY

ETCHED CIRCUIT BOARD ON ASSEMBLY

VERNIER — FRONT-PANEL MARKING

VERNIER — REAR-PANEL MARKING

MAIN SIGNAL PATH

PRIMARY FEEDBACK PATH

SECONDARY FEEDBACK PATH

SINGLE-PIN CONNECTOR ON BOARD

A — PIN OF A PLUG-IN BOARD (WITH LETTER OR NUMBER)

COAXIAL CABLE CONNECTED DIRECTLY TO BOARD

COAXIAL CABLE CONNECTED TO SNAP-ON JACK

FRONT-PANEL CONTROL

TP4 — TEST POINT (TP WITH NUMBER)

SCREWDRIVER ADJUSTMENT

7 — WAVEFORM TEST POINT (WITH NUMBER)

COMMON ELECTRICAL POINT (WITH LETTER); NOT NECESSARILY GROUND

70 — SIGNAL REFERENCE

9 — SCHEMATIC REFERENCE

BREAKDOWN DIODE (VOLTAGE REGULATOR)

LIGHT EMITTING DIODE (LED)

TUNNEL DIODE

G D S — FIELD-EFFECT TRANSISTOR (N-TYPE BASE)

CIRCUITS OR COMPONENTS DRAWN WITH DASHED LINES (PHANTOM) SHOW FUNCTION ONLY AND ARE NOT INTENDED TO BE COMPLETE. THE CIRCUIT OR COMPONENT IS SHOWN IN DETAIL ON ANOTHER SCHEMATIC.

(925) WIRE COLORS ARE GIVEN BY NUMBERS IN PARENTHESES USING THE RESISTOR COLOR CODE

(925) IS WHT-RED-GRN

0 - BLACK	5 - GREEN
1 - BROWN	6 - BLUE
2 - RED	7 - VIOLET
3 - ORANGE	8 - GRAY
4 - YELLOW	9 - WHITE

* OPTIMUM VALUE SELECTED AT FACTORY, TYPICAL VALUE SHOWN; PART MAY HAVE BEEN OMITTED.

UNLESS OTHERWISE INDICATED ALL LOGIC ELEMENTS ARE OF THE TTL LOGIC FAMILY.

UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS AND INDUCTANCE IN MICROHENRIES

CW — CLOCKWISE END OF VARIABLE RESISTOR

NC — NO CONNECTION

P/O — PART OF

VF (A) — V - VOLTAGE; F - FILTERED; (A) - FILTER SOURCE

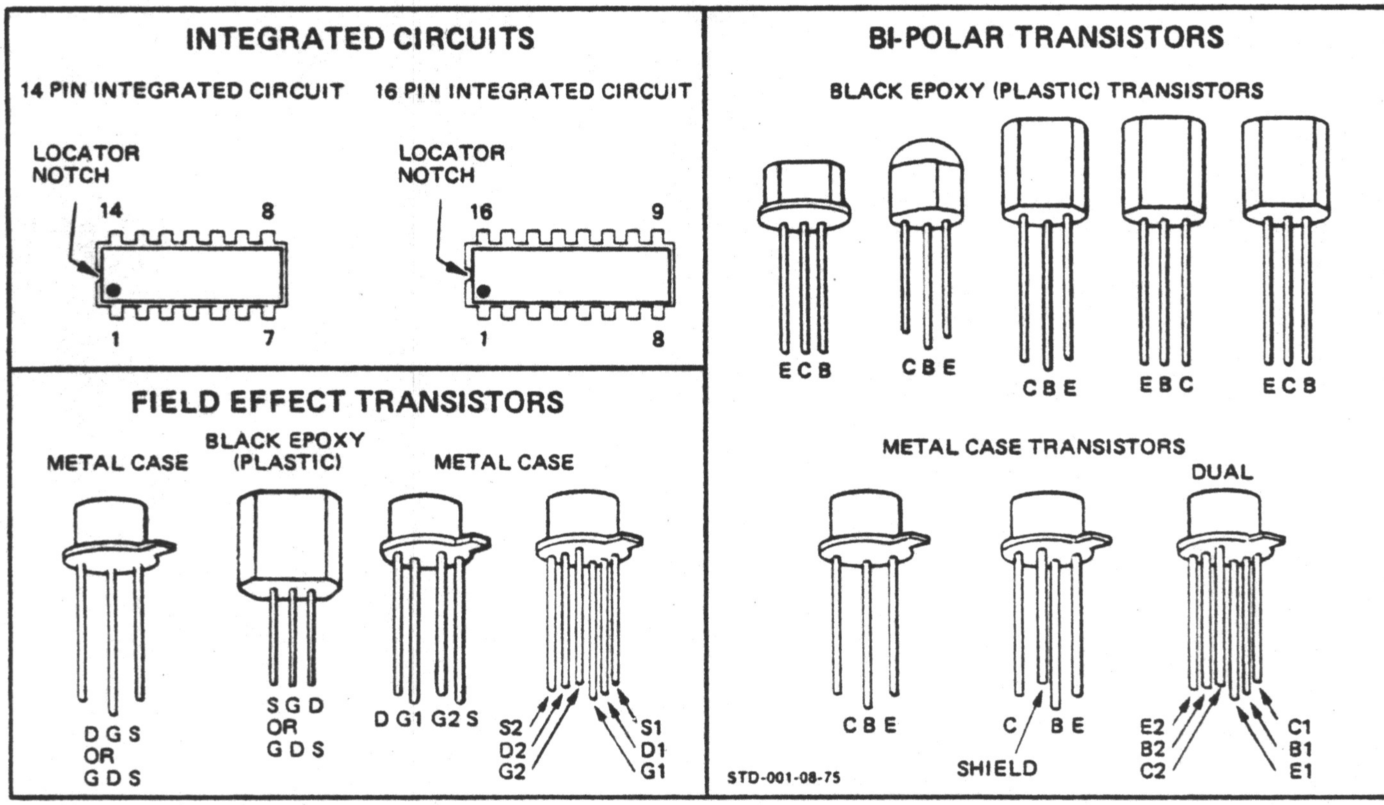


Figure 8-1. Semiconductor Terminal Identification

SERVICE SHEET 1

BASIC PRINCIPLES OF OPERATION

GENERAL. The following paragraphs contain functional descriptions keyed to the simplified block diagram on Schematic 1. The block diagram is drawn for function and does not show circuit details. Schematics and detailed descriptions of each circuit are located on subsequent service sheets. Refer to table 8-2 for assembly/service sheet identification.

Table 8-2. Assembly Index

Assembly	Name	Service Sheet(s)
A1	Main Board Assembly	4, 5, 6
A2	X-Y Board Assembly	2, 3, 6
A3	High Voltage Board Assembly	6

LOW-VOLTAGE POWER SUPPLY (SERVICE SHEET 5). The low-voltage power supply (not shown on the block diagram) converts the ac line input to three regulated dc voltages, +15 V, —15 V, and +100 V. Approximately +26 V is tapped off the unregulated +15 V supply for use in the high-voltage oscillator circuit.

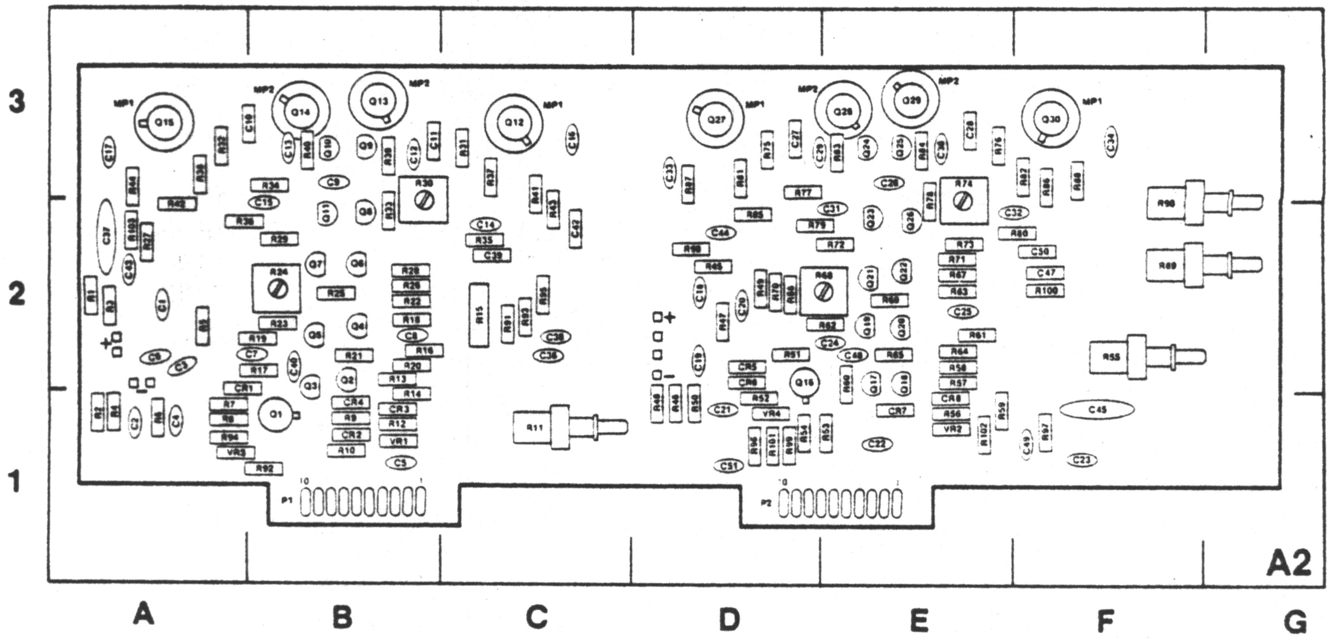
HIGH-VOLTAGE POWER SUPPLY (SERVICE SHEET 6). The high-voltage power supply provides voltages to operate the CRT ≈—4 kV for the cathode voltage, a grid voltage referenced to the cathode, CRT filament voltage, and a post accelerator voltage of ≈18 kV.

X- AND Y-AMPLIFIER CIRCUITS (SERVICE SHEETS 2 AND 3). The X- and Y-amplifier circuits are identical. They amplify the input signals to the necessary level to drive the CRT horizontal and vertical deflection plates. Facilities for adding feedback capacitance are provided to decrease bandwidth of the amplifier, if desired.

Z-AXIS AMPLIFIER (SERVICE SHEET 4) The signal applied to the Z-axis input is amplified to provide the voltage required to drive the CRT control grid. This permits external control of the CRT beam intensity.

TROUBLESHOOTING

Use the block diagram and Section V of this manual to isolate the trouble to a specific section of the instrument. Next, refer to the service sheets which cover that section, and isolate the trouble to a specific circuit or component.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-2	C26	E-3	CR3	B-1	Q18	E-2	R12	B-1	R36	A-2	R60	E-2	R84	E-3
C2	A-1	C27	D-3	CR4	B-1	Q19	E-2	R13	B-2	R37	C-3	R61	E-2	R85	D-2
C3	A-2	C28	E-3	CR5	D-2	Q20	E-2	R14	B-1	R38	A-3	R62	E-2	R86	F-1
C4	A-1	C29	D-3	CR6	D-2	Q21	E-2	R15	B-2	R39	B-3	R63	E-2	R87	D-3
C5	B-1	C30	E-3	CR7	E-1	Q22	E-2	R16	B-2	R40	B-3	R64	E-2	R88	F-1
C6	A-2	C31	E-2	CR8	E-1	Q23	E-2	R17	B-2	R41	C-3	R65	E-2	R89	F-2
C7	B-2	C32	F-3	P1	B-1	Q24	E-3	R18	B-2	R42	A-2	R66	D-2	R90	F-2
C8	B-2	C33	D-3	P2	D-1	Q25	E-3	R19	B-2	R43	C-2	R67	E-2	R91	C-2
C9	B-3	C34	F-1	Q1	B-1	Q26	E-2	R20	B-2	R44	A-3	R68	E-2	R92	B-1
C10	B-3	C36	C-2	Q2	B-2	Q27	D-3	R21	B-2	R45	D-2	R69	E-2	R93	C-2
C11	B-3	C37	A-2	Q3	B-2	Q28	E-3	R22	B-2	R46	D-1	R70	D-2	R94	A-1
C12	B-3	C38	C-2	Q4	B-2	Q29	E-3	R23	B-2	R47	D-2	R71	E-2	R95	C-2
C13	B-3	C39	C-2	Q5	B-2	Q30	F-1	R24	B-2	R48	D-1	R72	E-2	R96	D-1
C14	C-2	C40	B-2	Q6	B-2	R1	A-2	R25	B-2	R49	D-2	R73	E-2	R97	F-1
C15	B-2	C42	C-2	Q7	B-2	R2	A-1	R26	B-2	R50	D-1	R74	E-3	R98	D-2
C16	C-3	C43	A-2	Q8	B-2	R3	A-2	R27	A-2	R51	D-2	R75	D-3	R99	D-1
C17	A-3	C44	D-2	Q9	B-3	R4	A-1	R28	B-2	R52	D-1	R76	E-3	R100	F-2
C18	D-2	C45	F-1	Q10	B-3	R5	A-2	R29	B-2	R53	E-1	R77	D-3	R101	D-1
C19	D-2	C47	F-2	Q11	B-2	R6	A-1	R30	B-3	R54	D-1	R78	E-3	R102	E-1
C20	D-2	C48	E-2	Q12	C-3	R7	A-1	R31	C-3	R55	F-2	R79	D-2	R103	A-2
C21	D-1	C49	F-1	Q13	B-3	R8	A-1	R32	A-3	R56	E-1	R80	F-2	VR1	B-1
C22	E-1	C50	F-2	Q14	B-3	R9	B-1	R33	B-2	R57	E-2	R81	D-3	VR2	E-1
C23	F-1	C51	D-1	Q15	A-3	R10	B-1	R34	B-3	R58	E-2	R82	F-1	VR3	A-1
C24	E-2	CR1	A-2	Q16	D-2	R11	C-1	R35	C-2	R59	E-1	R83	E-3	VR4	D-1
C25	E-2	CR2	B-1	Q17	E-2										

Figure 8-3. X-Y Board Component Locator

1332A-016-11-77

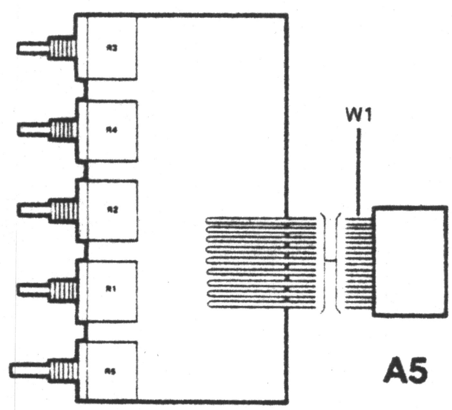


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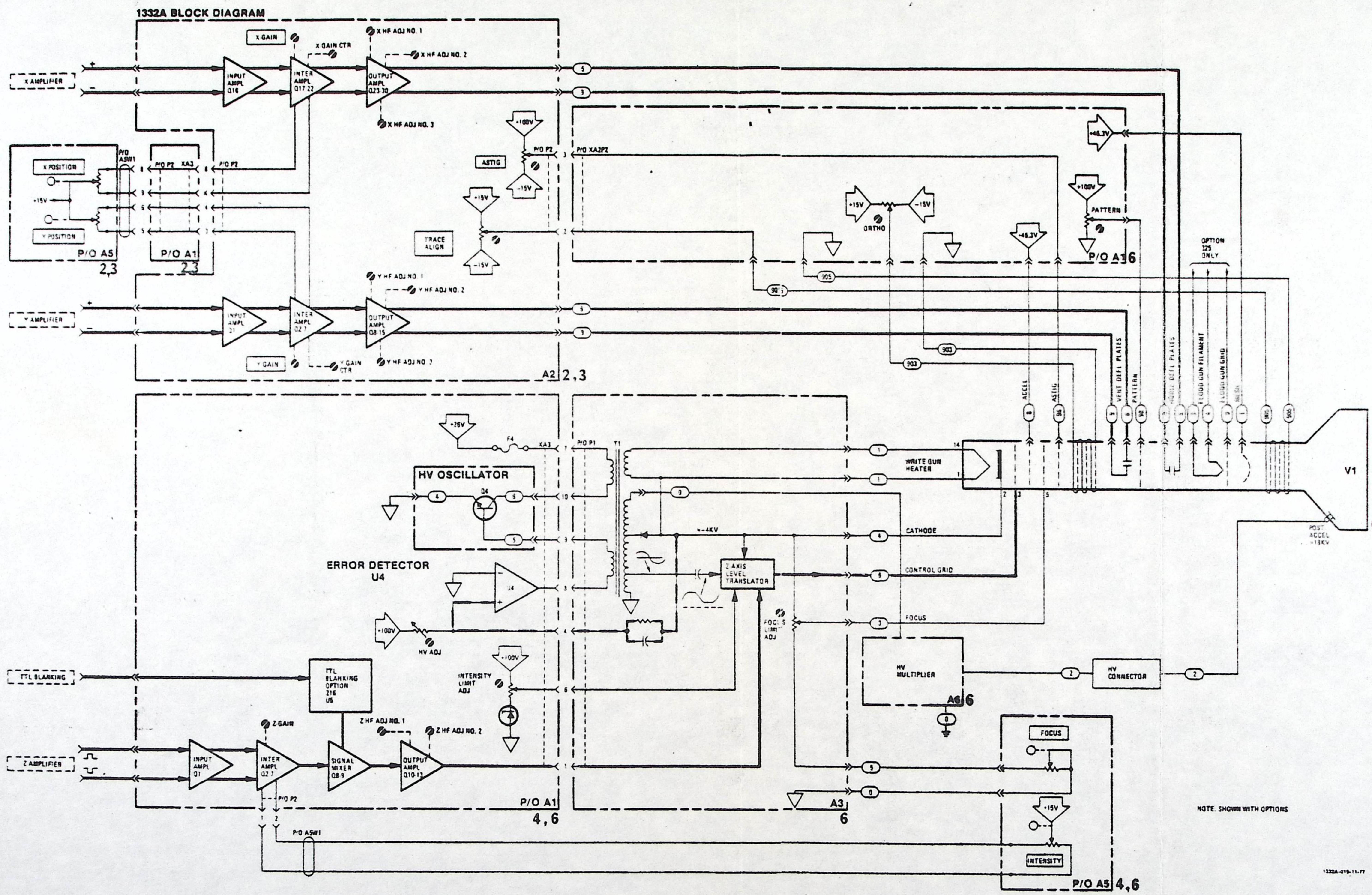
Figure 8-4. A5 Control Board Component Locator



1

Figure 8-2. Service Sheet 1, Overall Block Diagram

SCHEMATIC NOTES

	STD	OPTION 100	OPTION 101	OPTION 105	OPTION 106	OPTION 110	OPTION 120	OPTION 121
1	R45, R46 1M					R45, R46 50		
2	C18, C19 .01UF	C18, C19 1.9-15.7PF	C18, C19 1.9-15.7PF					
3	R47, R48 100K	R47, R48 800K	R47, R48 900K					
4	R49, R50 NOT USED	R49, R50 200K	R49, R50 100K					
5	C20, C21 NOT USED	C20, C21 43	C20, C21 43					
6	C24, C25 NOT USED							C24, C25 160
7	JUMPER NOT USED			JUMPER USED				
8	J3 USED			J3 NOT USED	J3 USED			
9	JUMPER USED							
10	J4 NOT USED				J4 USED			
11	C26 200 R69 681 R70 3.92K R71 3.92K R72 61.9K R73 61.9K R75 20K R76 20K R77 6.8K R78 6.8K R79 43.2K R80 43.2K R85 5.11K R86 5.11K R87 1.5K R88 1.5K						C26 36 R69 383 R70 1960 R71 1960 R72 47.5K R73 47.5K R75 10K R76 10K R77 3650 R78 3650 R79 22.1K R80 22.1K R85 2740 R86 2740 R87 750 R88 750	

SCHEMATIC NOTES

	STD	OPTION 100	OPTION 101	OPTION 105	OPTION 106	OPTION 110	OPTION 120	OPTION 121
1	R1, R2 1M					R1, R2 50		
2	C1, C2 .01UF	C1, C2 1.9-15.7PF	C1, C2 1.9-15.7PF					
3	R3, R4 100K	R3, R4 800K	R3, R4 900K					
4	R5, R6 NOT USED	R5, R6 200K	R5, R6 100K					
5	C3, C4 NOT USED	C3, C4 43	C3, 4 43					
6	C7, C8 NOT USED							C7, C8 160
7	JUMPER NOT USED			JUMPER USED				
8	J1 USED			J1 NOT USED	J1 USED			
9	JUMPER USED							
10	J2 NOT USED				J2 USED			
11	C9 200 R25 681 R26 3.92K R27 3.92K R28 61.9K R29 61.9K R31 20K R32 20K R33 6.8K R34 6.8K R35 43.2K R36 43.2K R41 5.11K R42 5.11K R43 1.5K R44 1.5K						C9 36 R25 383 R26 1960 R27 1960 R28 47.5K R29 47.5K R31 10K R32 10K R33 3650 R34 3650 R35 22.1K R36 22.1K R41 2740 R42 2740 R43 750 R44 750	

25ns option

SERVICE SHEET 2

PRINCIPLES OF OPERATION

X-AXIS AMPLIFIER. The input signal is applied to field-effect transistor (FET) impedance converter Q16. The FET is connected as a source follower. Each FET gate circuit contains an RC combination of 100 kΩ/.01 μF, plus a 39-ohm resistor. This combination limits the maximum current that can be applied to the FET and to protective diode circuit CR5/CR6 when the input is overdriven. This current-limiting feature does not affect the overall response to normal input signals. The drains and sources of the FET are supplied by two separate zener diode regulator circuits (VR2/VR4) for isolation purposes.

Gain Control Stages. Transistors Q17 through Q22 make up the gain control circuit, the position control circuit, and the bandwidth limit circuit (if used). Q17 and Q18 are connected as a paraphase amplifier whose outputs are two equal, but opposite phase currents that drive shunt-feedback amplifiers Q19 and Q20 respectively.

Front-panel X-GAIN control R55 is connected between the emitters of the paraphase amplifier stage and, at maximum gain (minimum resistance), a 1-volt input signal produces a change of ≈0.9 mA at the collectors of Q17 and Q18. Voltage change at the collectors of Q19 and Q20 for a 1-volt input signal is ≈3.6 volts differentially.

Transistors Q21 and Q22 convert the voltage signal to a proportional current signal required to drive the output amplifiers. The current output of Q21 and Q22 for a 1-volt input signal is controlled by X-GAIN control R55 and X-gain ctr adjustment R68. Signal current at the collectors of Q21 and Q22 is ≈5 mA when both R55 and R68 are set to maximum.

Since the CRT horizontal deflection plates are driven by two separate but identical output amplifiers, only one will be discussed. Transistors Q23 and Q24 are emitter followers, while Q27 and Q28 are a complementary pair. Normal signal flow is through Q24 and Q28; however, Q23 and Q24 are ac coupled to Q27 to change the current level during fast transitions. A feedback circuit is provided through C27/R75 with C27 providing adjustment for the fast corner of the signal. Slower compensation is provided by lag-compensation network C26/R74 connected differentially across the two amplifier inputs.

TROUBLESHOOTING

If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Verify that all circuit board connections are making good contact. If no obvious trouble is found, check the power supply voltages in the unit. Before any extensive troubleshooting, check the external power source also.

Troubleshooting Hints. Since most stages in the X-axis amplifier section are current amplifiers, signal tracing becomes difficult. When troubleshooting the X-axis amplifier, check the dc bias voltages indicated for active components. Voltage measurement conditions are listed on the schematic.

NOTE

All voltages are referenced to chassis ground. All indications on the schematic are nominal and 15% variation from those indicated should be considered normal.

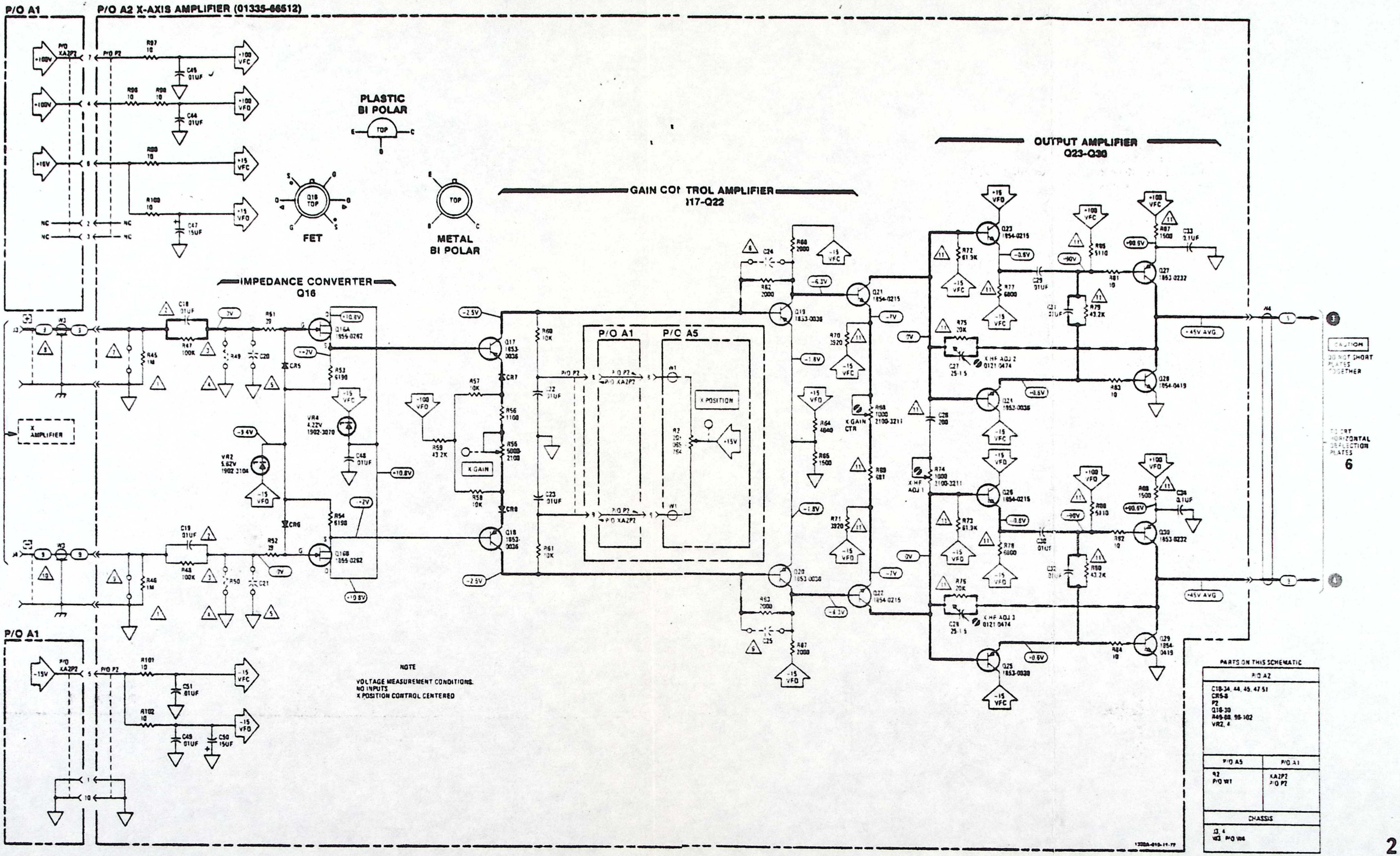


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Figure 8-5. Service Sheet 2, X-axis Amplifier Schematic

SERVICE SHEET 3

PRINCIPLES OF OPERATION

Y-AXIS AMPLIFIER. The input signal is applied to field-effect transistor (FET) impedance converter Q1. The FET is connected as a source follower. Each FET gate circuit contains an RC combination of 100 kΩ/.01 μF, plus a 39-ohm resistor. This combination limits the maximum current that can be applied to the FET and protective diode circuit CR1/CR2 when the input is overdriven. This current-limiting feature does not affect the overall response to normal input signals. The drains and sources of the FET are supplied by two separate zener diode regulator circuits for isolation purposes.

Gain Control Stages. Transistors Q2 through Q7 make up the gain control circuit, the position control circuit, and the bandwidth limit circuit (if used). Transistors Q2 and Q3 are connected as a paraphase amplifier whose outputs are two equal, but opposite phase currents that drive shunt-feedback amplifiers Q4 and Q5 respectively.

Front-panel Y-GAIN control R11 is connected between the emitters of the paraphase amplifier stage and, at maximum gain (minimum resistance), a 1-volt input signal produces a change of ≈0.9 mA at the collectors of Q2 and Q3. Voltage change at the collectors of Q4 and Q5 for a 1-volt input signal is ≈3.6 volts differentially.

Transistors Q6 and Q7 convert the voltage signal to a proportional current signal required to drive the output amplifiers. The current output of Q6 and Q7 for a 1-volt input signal is controlled by Y-GAIN control R11 and Y-gain ctr control R24. Signal current at the collectors of Q6 and Q7 is ≈5 mA when both R11 and R24 are set to maximum.

Since the CRT vertical deflection plates are driven by two separate but identical output amplifiers, only one will be discussed. Transistors Q8 and Q9 are emitter followers, while Q12 and Q13 are a complementary pair. The normal signal flow is through Q9 and Q13; however, Q8 and Q9 are ac coupled to Q12 to change the current level during fast transitions. A feedback circuit is provided through C11/R31 with C11 providing adjustment for the fast corner of the signal. Slower compensation is provided by lag-compensation network C9/R30 connected differentially across the two amplifier inputs.

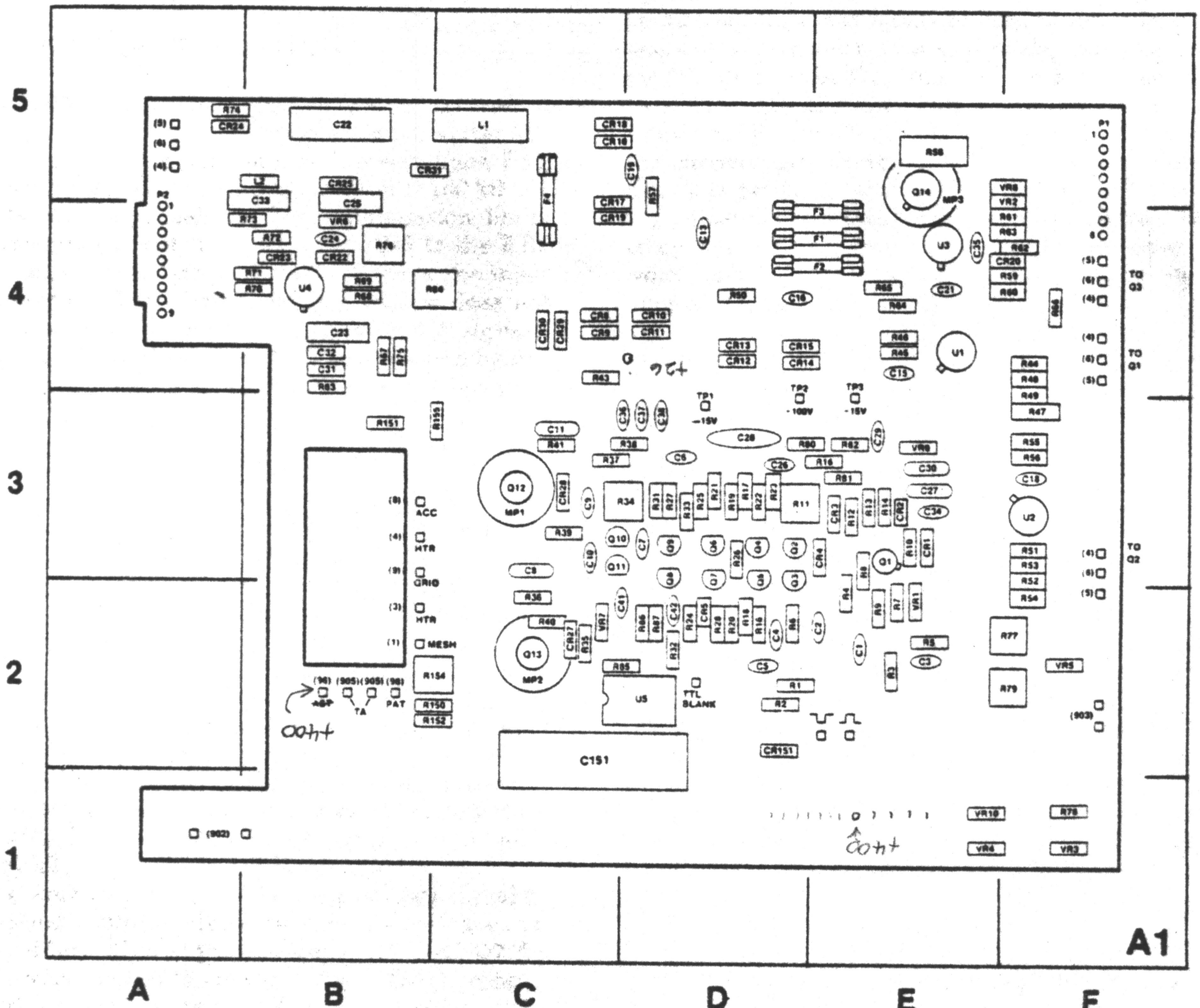
TROUBLESHOOTING

If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Verify that all circuit board connections are making good contact. If no obvious trouble is found, check the power supply voltages in the unit. Before any extensive troubleshooting, check the external power source also.

Troubleshooting Hints. Since most stages in the Y-axis amplifier section are current amplifiers, signal tracing becomes difficult. When troubleshooting the Y-axis amplifier, check the dc bias voltages indicated for active components. Voltage measurement conditions are listed on the schematic.

NOTE

All voltages are referenced to chassis ground. All indications on the schematic are nominal and 15% variation from those indicated should be considered normal.



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REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-2	C30	E-3	CR16	C-5	P2	A-5	R11	D-3	R38	D-3	R64	E-4	R150	B-2
C2	E-2	C31	B-4	CR17	C-5	Q1	E-3	R12	F-3	R39	C-3	R65	E-4	R151	B-3
C3	E-2	C32	B-4	CR18	C-5	Q2	D-2	R13	F-3	R40	C-2	R66	F-4	R152	B-2
C4	D-2	C33	A-4	CR19	C-4	Q3	D-3	R14	F-3	R41	C-3	R67	B-4	R154	B-2
C5	D-2	C34	E-3	CR20	F-4	Q4	D-3	R15	F-3	R43	C-4	R68	B-4	R155	B-3
C6	D-3	C35	E-4	CR22	B-4	Q5	D-3	R16	D-2	R44	F-4	R69	B-4	TP1	D-3
C7	D-3	C36	D-3	CR23	A-4	Q6	D-3	R17	D-3	R45	E-4	R70	A-4	TP2	D-4
C8	C-3	C37	D-3	CR24	B-5	Q7	D-3	R18	D-2	R46	E-4	R71	A-4	TP3	E-4
C9	C-3	C38	D-3	CR25	B-5	Q8	D-3	R19	D-3	R47	F-3	R72	A-4	U1	E-4
C10	C-3	C41	D-2	CR27	C-2	Q9	D-3	R20	D-2	R48	F-4	R73	A-4	U2	F-3
C11	C-3	C42	D-2	CR28	C-3	Q10	D-3	R21	D-3	R49	F-4	R74	A-5	U3	E-4
C13	D-4	C151	C-2	CR29	C-4	Q11	D-2	R22	D-3	R50	D-4	R75	B-4	U4	B-4
C15	E-4	CR1	E-3	CR30	C-4	Q12	C-3	R23	D-3	R51	F-3	R76	B-4	U5	D-2
C16	D-4	CR2	F-3	CR31	B-5	Q13	C-2	R24	D-2	R52	F-2	R77	F-2	VR1	E-2
C18	F-3	CR3	E-3	CR151	D-2	Q14	E-5	R25	D-3	R53	F-2	R78	F-1	VR2	F-5
C19	C-5	CR4	E-3	F1	E-4	R1	D-2	R26	D-3	R54	F-2	R79	F-2	VR3	F-1
C21	E-4	CR5	D-2	F2	E-4	R2	D-2	R27	D-3	R55	F-3	R80	D-3	VR4	E-1
C22	B-5	CR8	C-4	F3	E-4	R3	E-2	R28	D-2	R56	F-3	R81	E-3	VR5	F-2
C23	B-4	CR9	C-4	F4	C-4	R4	E-2	R31	D-3	R57	D-5	R82	E-3	VR6	B-4
C24	B-4	CR10	D-4	L1	C-5	R5	E-2	R32	D-2	R58	E-5	R83	B-4	VR7	C-2
C25	B-4	CR11	D-4	L2	A-5	R6	D-2	R33	D-3	R59	F-4	R84	B-4	VR8	F-5
C26	D-3	CR12	D-4	MP1	C-3	R7	E-2	R34	D-3	R60	F-4	R85	D-2	VR9	E-3
C27	E-3	CR13	D-4	MP2	C-2	R8	E-3	R35	C-2	R61	F-4	R86	D-2	VR10	E-1
C28	D-3	CR14	D-4	MP3	E-5	R9	E-2	R36	C-2	R62	F-4	R87	D-2		
C29	E-3	CR15	D-4	P1	F-5	R10	E-3	R37	C-3	R63	F-4				

Figure 8-7. A1 Main Board Component Locator (front)

Gamma TTL

SCHEMATIC NOTES

Note	STD	OPTION 200	OPTION 201	OPTION 205	OPTION 206	OPTION 210	OPTION 211	OPTION 215	OPTION 216
1	R1, R2 1M					R1, R2 50	R1, R2 75		
2	C1, C2 .01UF	C1, C2 1.7-11	C1, C2 1.7-11						
3	R3, 4 100K	R3, 4 800K	R3, 4 900K						
4	R5, 6 NOT USED	R5, 6 200K	R5, 6 100K						
5	C3, C4 NOT USED	C3, C4 20	C3, C4 20						
6	CR5 NOT USED R26 619 R28 NOT USED							CR5 USED R26 1100 R28 909	
7	R32 USED								NOT USED
8	NOT USED								C41 .01UF C42 .01UF CR26 J7 R87-8.25K R85 22K R86 33.2K U5 VR7
9	JUMPER USED								
10	JUMPER NOT USED			JUMPER USED					
11	J5 USED			J5 NOT USED	J5 USED				
12	J6 NOT USED				J6 USED				

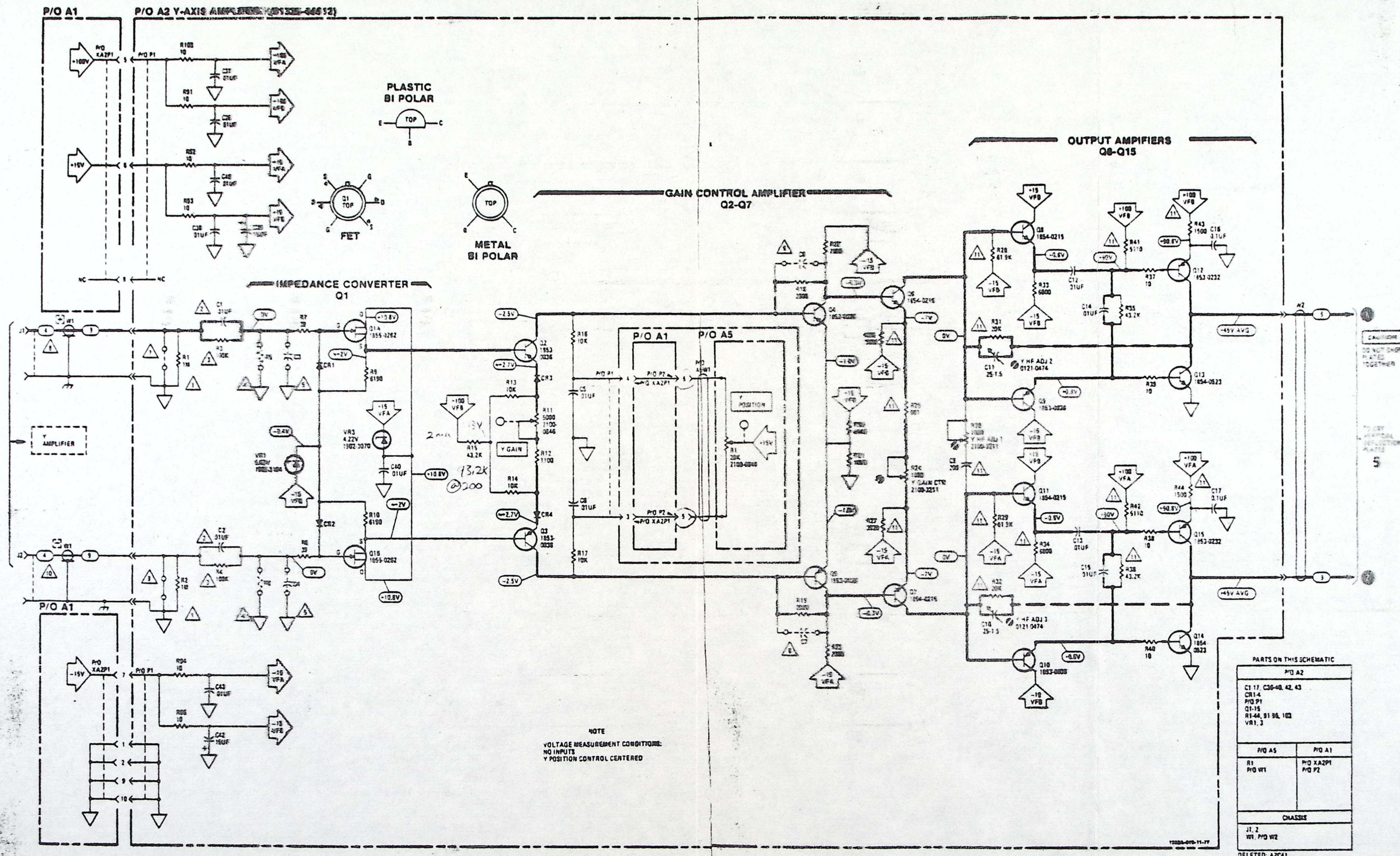

Figure 8-6. Service Sheet 3, Y-axis Amplifier Schematic

SERVICE SHEET 4

PRINCIPLES OF OPERATION

Z-AXIS AMPLIFIER. Input Network and Impedance Converter. The standard instrument has an input impedance of 1 megohm. Options are available for changing the impedance to 50 or 75 ohms. The standard CRT blanking range of 0 to 1 V can be changed with options to 0 to 5 V or 0 to 10 V. Options are also available for fully differential input and unblanking the trace with a negative input.

The input signal is applied to field-effect transistor (FET) impedance converter Q1. The FET is connected as a source follower. The FET gate circuit contains an RC combination of 100 kΩ/.01 μF, plus a 39-ohm resistor. This combination limits the maximum current that can be applied to the FET and protective diode circuit (CR1/CR2)) when the input is overdriven. This current-limiting feature does not affect the overall response to normal input signals. The drains and sources of the FET are supplied by two separate zener diode regulator circuits (VR1/VR9) for isolation purposes.

Gain Control Stages. Transistors Q2 through Q9 make up the gain control circuit, optional input control circuits, and a drive current for the Z-axis output amplifier.

Q2 and Q3 are connected as a paraphase amplifier whose outputs are two equal, but opposite phase currents that drive shunt-feedback amplifiers Q4 and Q5 respectively. Z-gain control A1R11 is connected between the emitters of the paraphase amplifier and, at maximum gain (minimum resistance), a 1-volt input signal produces a current change of 1 milliampere at the collectors of Q2 and Q3. This current change produces a voltage change of ≈4 volts differentially at the collectors of Q4 and Q5.

Transistors Q6 and Q7 provide the necessary current to drive the output amplifiers. Q8 and Q9 allow an optional TTL blanking signal to override the Z-axis input and blank the CRT.

Z-axis Output Amplifier. Transistors Q10 and Q11 function as emitter followers, while Q12 and Q13 are a complementary pair. A feedback circuit is provided through C8/R36 with C8 providing adjustment for the fast corner of the signal. Slower compensation is provided by lag-compensation network C7/R34. Diode CR29 is a high-speed diode, and CR30 and CR31 are high-current diodes. Together they provide protection for the output amplifiers against arcs and transients. Under normal operation, the voltage at TP1 is ≈5 volts with the INTENSITY control set fully counterclockwise. With the INTENSITY control set fully clockwise, the voltage at TP1 will be ≈85 volts. The output of the Z-axis amplifier is applied to a level translator on high-voltage power supply assembly A3 where it establishes the potential difference between the grid and cathode of the CRT.

TROUBLESHOOTING

If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Verify that all circuit board connections are making good contact. If no obvious trouble is found, check the power supply voltages in the unit. Before any extensive troubleshooting, check the external power source also.

TROUBLESHOOTING HINTS. Since most stages in the Z-axis and the focus correction amplifiers are current amplifiers, signal tracing becomes difficult. When troubleshooting the Z-axis and the focus correction amplifiers, check the dc bias voltages indicated for active components. Voltage measurement conditions are listed on the schematic.

NOTE

> All voltages are referenced to chassis ground. All indications on the schematic are nominal and 15% variation from those indicated should be considered normal.

SERVICE SHEET 5

PRINCIPLES OF OPERATION

LOW-VOLTAGE POWER SUPPLY (LVPS). The low-voltage power supply converts the ac input line voltage to several dc levels required to power individual circuits in the instrument. All supplies except the +26-volt line to the HV oscillator are regulated.

±15-V Supplies. The +15 V and −15 V supplies function in the same manner; therefore, only the +5 V supply will be discussed. Line voltage from the secondary of T1 is rectified by diode bridge CR8 through CR11 and filtered by C14. The +26 V unregulated line is applied to HV oscillator Q4 through a 1-ampere fuse. The output voltage is sensed by R48 and R49 and compared to a reference voltage generated by U1. U1 then drives Q1 to maintain the voltage at U1 pin 2 equal to the reference voltage at U1 pin 3. R47 acts as a current sensor.

+100-V Supply. Regulated voltages V+ and Vc at pins 7 and 8 of U3 are provided by Q14, R58, and VR8. These voltages remain constant at +12.5 volts with respect to the +100 V supply output (pin 5 of U3).

The reference voltage, V_{REF} (pin 4) of U3, is approximately +7.15 volts with respect to V— (pin 5). The V_{REF} voltage, divided by resistor string R61/R62 and referenced to ground is applied to the non-inverting input (pin 3) of U3. The reference voltage is also divided by resistors R59 and R60 and is applied to the inverting input (pin 2) of A1U3; however, the inverting input sees the voltage applied to it with reference to the +100 V output. The noninverting and inverting input voltages will always be equal (within a few millivolts) when the regulator is functioning properly.

Diode CR20 provides turn-on protection for U3. During normal operation, CR20 is not conducting. Capacitor C21 is used to frequency-compensate the regulator. Resistor R66 is the current-sense resistor and, along with R64 and R65 provides current foldback for the +100 V supply. The current foldback feature reduces power dissipation of Q3 (chassis mounted) during overload conditions by reducing the output current to a low value. The current-sense input (pin 1) and the current limit input (pin 10) of U3 are the emitter and base junctions respectively of the over-current protect transistor (part of U3). The voltage difference between these two inputs should not exceed 0.45 volt (pin 10 positive with respect to pin 1) during normal operations.

The V_{REF} output from pin 4 of U3 (+7.15 volts with respect to V—) is developed by a temperature-compensated voltage source that is part of U3. Resistor network R59/R60 divides the reference voltage by two so that the inverting input voltage is always +3.55 volts above V—. If the output of the +100 V supply increases or decreases for some reason, the inverting input voltage will follow, but will remain +3.55 volts above V—. On the other hand, the reference voltage (developed through resistor network R61/R62 to ground) applied to the noninverting input will not follow the change in V— exactly due to values of R61 and R62. Only about 98% of the change will be reflected at the noninverting input. With different voltages applied to the inverting and non-inverting inputs, the output (pin 6) of U3 will vary, causing Q3 to increase or decrease its output as necessary to restore the output to +100 volts. Zener diode VR2 reduces the output of U3 to the base level of chassis-mounted Q3. Resistor R63 provides a current path for VR2. VR3 and VR4 act as limiters for the +100-V output during initial turn on.

TROUBLESHOOTING

If the LVPS is completely inoperative, inspect the line fuse located on the rear of the instrument. If the line fuse is open, the power lamps will not be lit. Check input voltage source for proper voltage.

The voltage from each secondary winding of input transformer T1 is rectified by a full-wave bridge rectifier and filtered by a capacitor (the +100 V supply is filtered by two capacitors). In the event of diode failure, the supply voltage will vary considerably from the design value and filtering will be severely affected. Loss of a filter capacitor will affect the voltage and result in excess ripple at the series regulator input.

Fuses and adjustments for the dc voltages are located on the mother board, A1. The fuses are connected in series with the regulator transistors. If a fuse is open, check the series regulator and driver transistors.

No output voltage may be the result of an open fuse, open series regulator transistor, or loss of the +100 V reference voltage. If all supplies are inoperative, check the +100 V power supply first.

Too high a voltage may be caused by a shorted series regulator transistor, shorted driver transistor, +100 V reference voltage out of regulation, or a defective sensor amplifier. If the ±5 V supplies are low, check the output of the +100 V supply.

If the +100-volt supply exceeds the acceptable range (+100 to +105 volts), check the resistor divider network A1R61 and A1R62 for proper values. Check for low input line voltage.

WARNING

Contact with the high-voltage power supply voltage can result in injury or death.

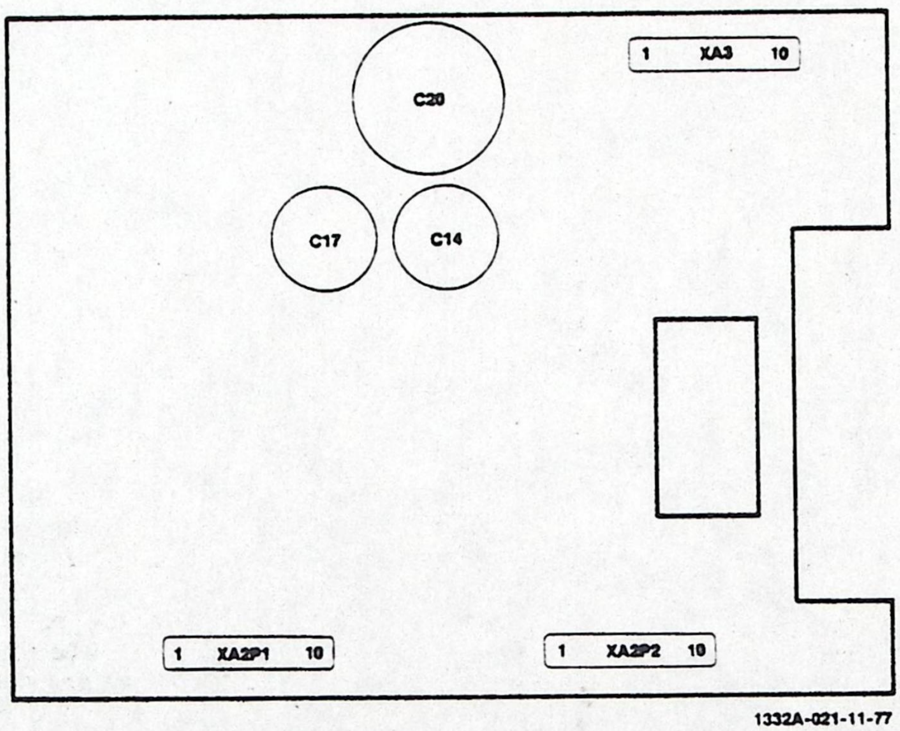

Figure 8-8. A1 Main Board Component Locator (back)

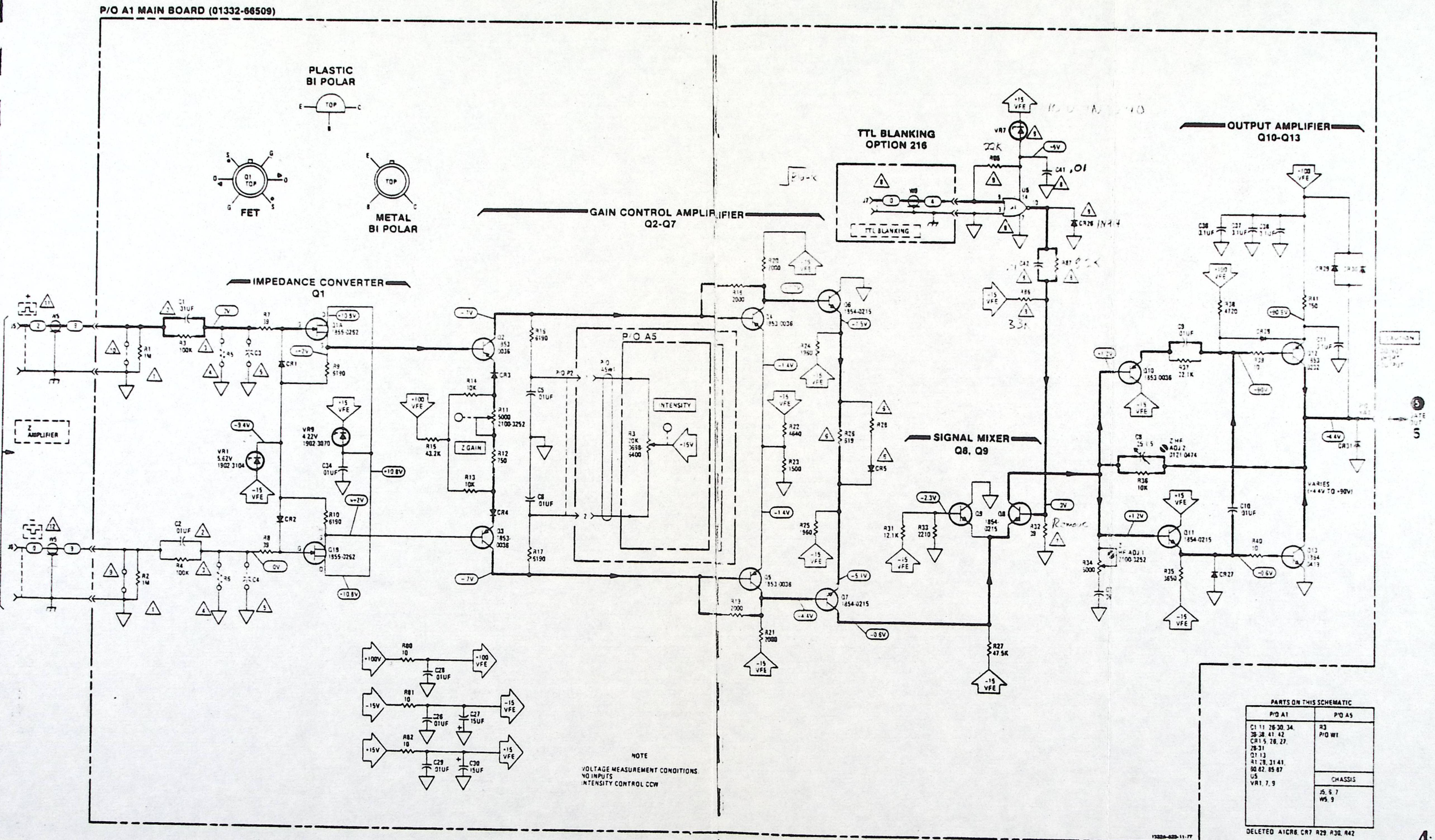

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Figure 8-9. Service Sheet 4. Z-axis Amplifier Schematic

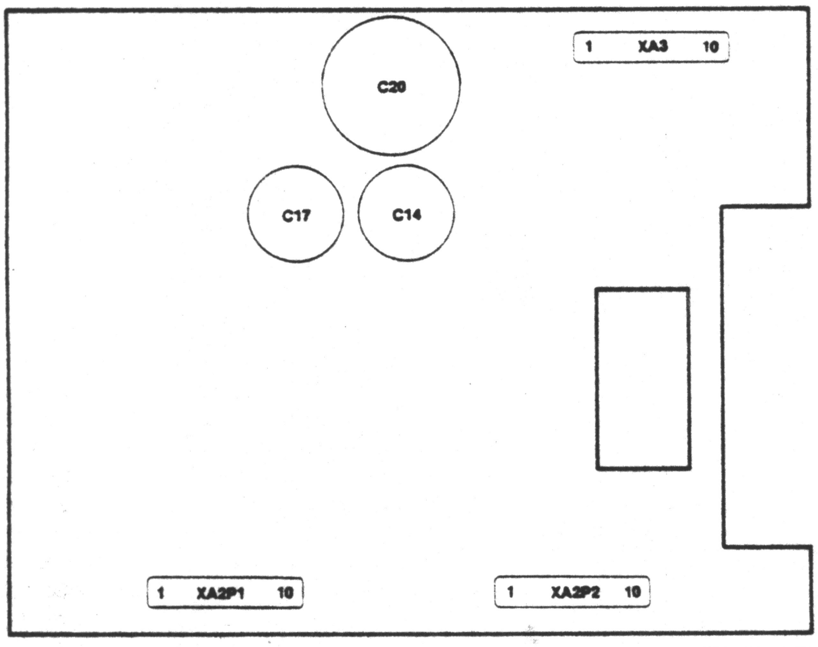


Figure 8-8. A1 Main Board Component Locator (back)

WARNING

The heater voltage is 4.65 Vac, but use extreme care when making this measurement because the ac voltmeter must be floated at —4000 volts. The common input of most ac powered voltmeters is not rated for this use; therefore, a battery operated unit is normally used. Do not contact the case of the ac voltmeter or its leads when measuring this high potential. Isolate voltmeter case from the 1332A chassis.

The required voltage for the accelerator electrode of the CRT is supplied from zener diode regulator A1VR10. Before reaching the phosphor, the deflected beam passes through an electronic lens, referred to as the CRT mesh. The mesh is supplied with a positive voltage from zener diode regulator A1VR10. The post accelerator is a conductive coating around the inner part of the CRT glass. It provides a high-accelerating field for the electron beam and collects electrons produced by secondary emission when the beam strikes the screen.

WARNING

Use extreme care when measuring the post accelerator voltage. The potential is approximately 18 kV with respect to ground and is dangerous to life.

TROUBLESHOOTING

POWER SUPPLY. Malfunction of the HVPS will usually result in loss of beam spot or unstable intensity. Troubleshooting may be accomplished by resistance checks of the high-voltage oscillator, high-voltage transformer, and regulator circuits. In the event of complete failure, check fuse A1F4. If the fuse is good, check +15 V supply. Failure of the +15 V supply will turn off high-voltage oscillator Q4. If HV Multiplier A6 fails, replacement (rather than repair) is required.

CRT REMOVAL.

WARNING

To prevent personal injury, wear a face mask or goggles when handling the CRT. Wear protective gloves and handle the CRT carefully.

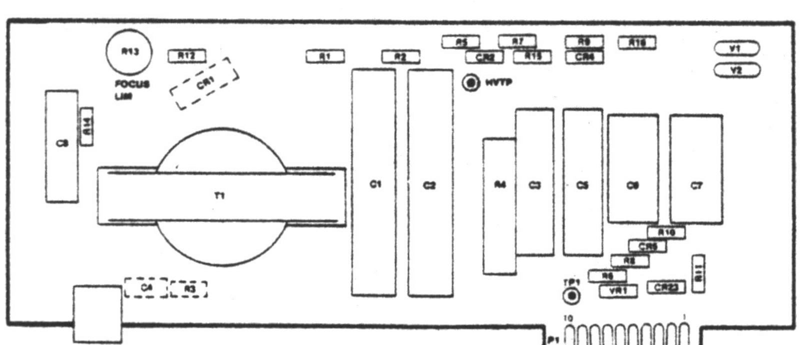
To remove the CRT, proceed as follows:

1. Disconnect cables from Control Board A5 to Main Board A1 and High-voltage Board A3.
2. Remove screws (two on each side) holding side rails to front panel assembly.
3. Lower front panel assembly.

CAUTION

Do not attempt to remove the CRT socket at an angle because it can break the CRT base and keyway.

4. Disconnect all wires from CRT.
5. Loosen base clamp.
6. Lift CRT and shield from instrument.
7. To reinstall CRT, reverse removal procedure.



A3

1332A-024-11-77

Figure 8-11. A3 High-voltage Board Component Locator

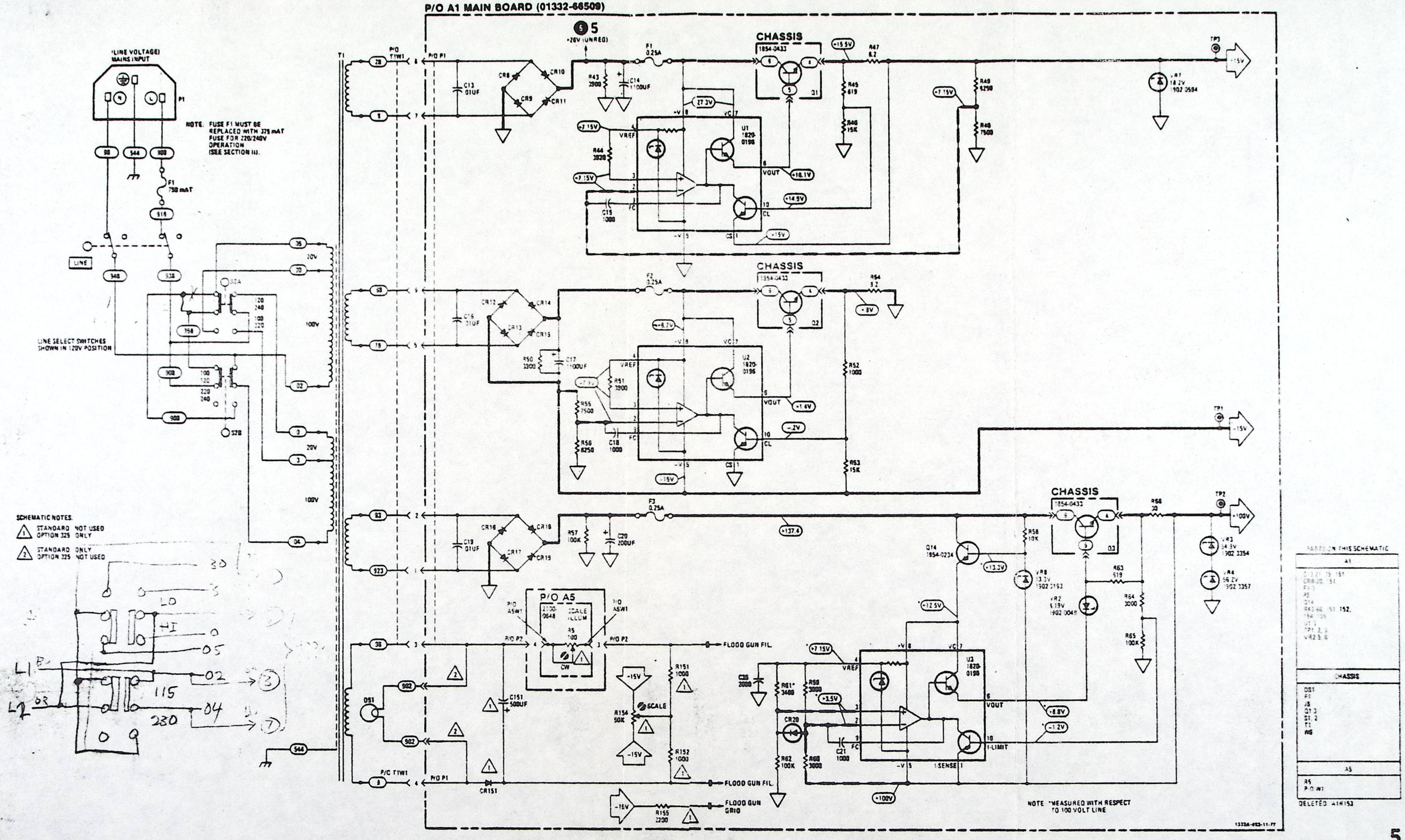


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Figure 8-10. Service Sheet 5, Low-voltage Power Supply Schematic

SERVICE SHEET 6

PRINCIPLES OF OPERATION

HIGH-VOLTAGE POWER SUPPLY (HVPS) See chassis mounted transistor Q4 and transformer A3T1 form an oscillator circuit with the main source of power coming from the +26 V unregulated low-voltage power supply. The circuit oscillates in the frequency range of 24 kHz to 25 kHz. The primary windings of transformer A3T1 are connected to provide positive feedback to the base of Q4 to sustain oscillations. Two windings are provided in the secondary of A3T1. One winding supplies high voltage, and the other supplies heater power to the CRT.

WARNING

Heater winding of the high-voltage transformer is connected to ≈—4 kV cathode potential and is dangerous to life. Use extreme caution when handling, testing, and adjusting.

The HV winding of A3T1 is tapped at terminal 6 and provides a sine wave for the level translator. The winding is also tapped at terminal 7 and applied to high-voltage multiplier A6 where the voltage is multiplied approximately six times, rectified, filtered, and then applied to the post accelerator of the CRT. The full output of the A3T1 secondary is rectified to provide the negative high voltage for the CRT cathode. Diode rectifier A3CR1 and filter network A3C1, A3C2, and A3R2 provide the ≈—4 kV potential for the cathode, grid reference level, and focus level. The focus level is divided by A3R12, A3R13, A3R14, and front-panel FOCUS control A5R4. Feedback for high-voltage regulator A1U4 is through A3C3 and A3R4. A level translator is used to shift the Z-axis amplifier output to the CRT control grid level.

The sine-wave signal from the secondary tap on high-voltage transformer A3T1 is applied through A3R30 A3C4 to the Z-axis level translator. The top and bottom of the sine wave are clipped as follows: The top of the sine wave is clipped by A1CR3. The clipping level is determined by the setting of INT LIMIT control A1R76. The bottom of the sine wave from A3T1 is clipped by the action of A3CR5. The lower clipping level is established by the Z-axis signal from the Z-axis amplifier (see schematic 4). With front-panel INTENSITY control A5R3 set for maximum intensity, the Z-axis amplifier output is at its highest level. This output causes maximum clipping action on the bottom section of the sine wave from A3T1. This results in the smallest peak-to-peak swing of the sine wave, since the upper clipping level is held constant by the setting of INT LIMIT control A1R76. As INTENSITY control A5R3 is turned toward minimum intensity, clipping action on the bottom of the sine wave becomes less, resulting in a greater peak-to-peak swing.

The clipped sine wave is ac coupled through A3C5 to a rectifier circuit consisting of A3CR2, A3CR4, and filter network A3C6, A3C7, and A3R9. The rectifier circuit provides a dc level equal to the peak-to-peak amplitude of the clipped sine wave. The dc level is referenced to the cathode potential. Diodes A3CR2 and A3CR4 are connected so that the dc level established is negative with respect to the cathode and is applied to the CRT grid through A3R6. Capacitors A3C6 and A3C7 are not returned directly to the cathode, but are connected to the Z-axis amplifier output for coupling fast Z-axis transitions to the grid.

High-voltage Regulator. Operational amplifier A1U4 compares the voltage at the junction of A1R84 and A3R4 (with respect to ground, 0 V) and drives HV oscillator Q4 to correct for any differences. Since the input of A1U4 (pin 3) is a very high resistance, it will draw negligible current. Therefore, current flow between the +100 V regulated supply and the —4 kV cathode voltage is established by resistor string A1R67, A1R84, and A3R4, with the junction of A1R84 and A3R4 being held at 0 V by the action of A1U4. For example, if the high voltage goes more negative, the input to A1U4 (pin 3) will start to go negative and its output (pin 6) will follow. This applies a more negative average voltage to the feedback winding on HV transformer A3T1. Since HV oscillator Q4 is an NPN device (conducts only on positive peaks of the base waveform), the more negative average voltage applied to A3T1 causes the oscillator to conduct less, and for a shorter period of time. With Q2 conducting less, less power is available in the transformer and the hv output will go in a positive direction, returning the high voltage to its previously adjusted level.

CRT Beam Alignment. Two coils (located inside the CRT shield) provide beam alignment for the display. Ortho coil L2 is physically located around the Y-axis deflection plates and causes the vertically deflected beam to enter the X-axis horizontal deflection plates at a 90° angle to their physical mounting plane. The second coil (L1-trace align) is located over the mesh area of the CRT and rotates the deflected beam to align it with the horizontal plane of the cabinet (or graticule, if used).

Cathode-ray Tube. In addition to the cathode, control grid, focus grid, Y- and X-deflection plates discussed previously, the CRT contains other elements vital to its operation. The heater is powered by a separate winding on the HV transformer, A3T1, and is raised to the cathode potential through A3R1 to prevent heater-to-cathode breakdown.

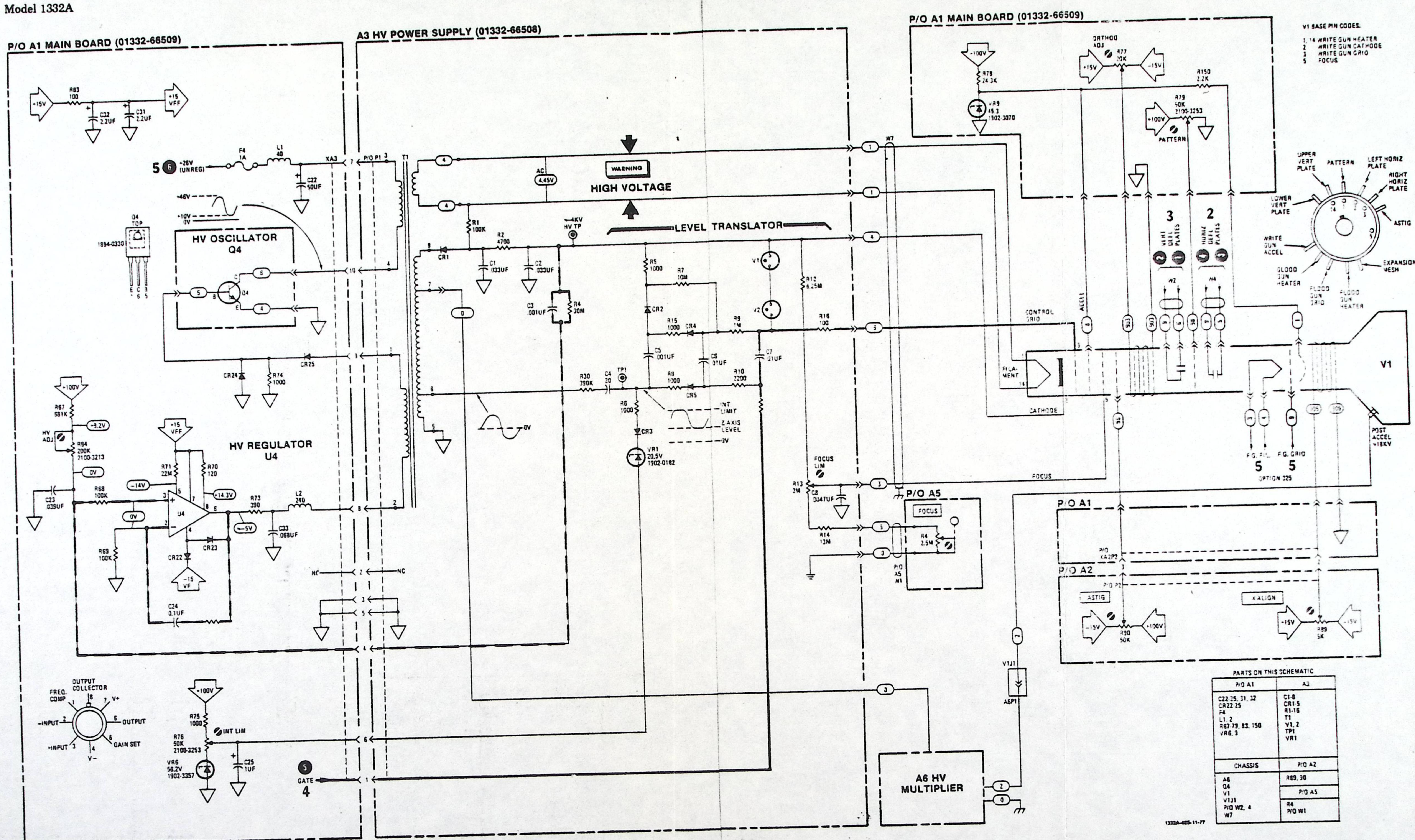


Figure 8-12. Service Sheet 6, High-voltage Power Supply Schematic

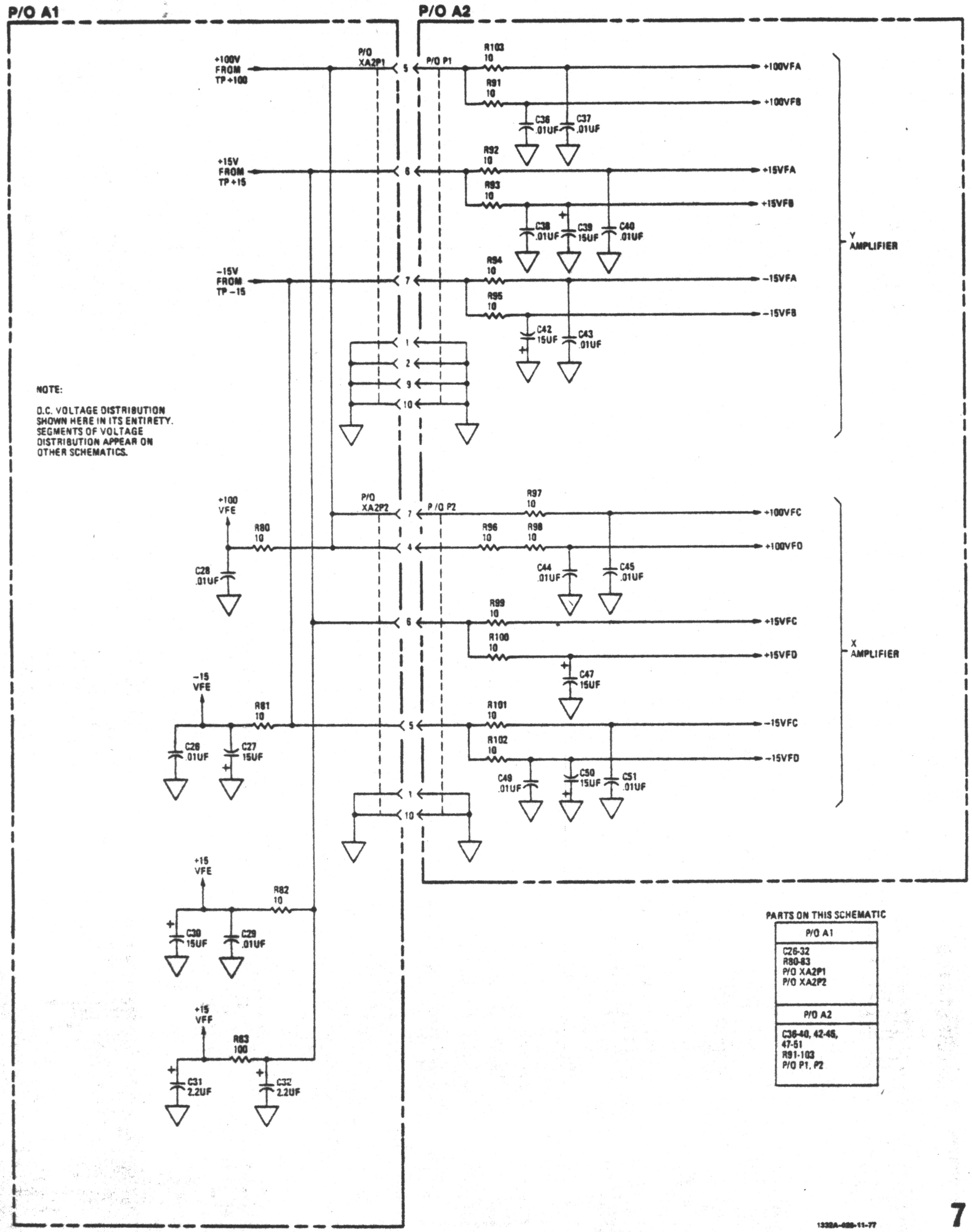


Figure 8-13. Service Sheet 7, DC Voltage Distribution Schematic

SECTION V

ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section describes adjustments and checks required to return the instrument to peak operating capabilities when repairs have been made. Included in this section are equipment setups and adjustment procedures.

5-3. SAFETY REQUIREMENTS.

5-4. Although this instrument has been designed in accordance with international safety standards, general safety precautions must be observed during all phases of operation, service, and repair of the instrument. Failure to comply with the precautions listed in the Safety Summary at the front of this manual or with specific warnings given throughout this manual could result in serious injury or death. Service and adjustments should be performed only by qualified service personnel.

5-5. EQUIPMENT REQUIRED.

5-6. A complete list of required test equipment is given in Section I, table 1-4. Test equipment equivalent to that recommended may be substituted, provided it meets the required characteristics. For best results, use recently calibrated test equipment.

5-7. ADJUSTMENTS.

5-8. The adjustments given in this section are not interrelated. Refer to table 5-1 for a list of adjustable components and their functions.

5-9. After repair, the adjustments affected should be made, but a complete readjustment of the instrument is unnecessary. Prior to any adjustment, however, the power supply outputs should be checked for proper voltage levels.

NOTE

Before making any adjustments, eliminate static charge from glass of the CRT faceplate by solidly grounding one hand while rubbing the CRT faceplate with the other hand.

5-10. In addition to the complete step-by-step adjustment procedures, a condensed adjustment procedure is provided in table 5-2 for the convenience of those technicians who have sufficient experience with the 1332A. For best results, allow the instrument to warm up for 15 minutes before making adjustments. Adjustment locations are shown on figure 8-14.

5-11. ADJUSTMENT PROCEDURES.

WARNING

Use extreme caution when instrument covers are removed and power is applied. Voltages up to 18 kV are present around the CRT area and are capable of causing serious injury or death. Read the Safety Summary at the front of this manual before performing adjustment procedures.

5-12. LOW-VOLTAGE POWER SUPPLY CHECK.

REFERENCE:
Schematic 5.

DESCRIPTION:
Low-voltage power supply has no adjustments. Outputs of the low-voltage power supply should be checked for proper voltages.

EQUIPMENT:
DMM (Digital Multimeter)............... HP 3476A

PROCEDURE:
Check for proper output voltages of the low-voltage power supply as indicated in the adjacent table.

CAUTION

Voltage magnitude at A1TP2 must not exceed +105V.

Low-voltage Power Supply Outputs

Power Supply	Test Point	Range
+15 V	A1TP3	+14.25 V to +15.75 V
—15 V	A1TP1	—14.25 V to —15.75 V
+100 V	A1TP2	+100 V to +105 V

Table 5-1. Adjustable Components

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R84	HV ADJ	5-13	6	Adjust for proper CRT filament voltage CAUTION: See Paragraph 5-13
A1R76	INT LIMIT	5-14	6	Sets maximum intensity limit for CRT CAUTION: See Paragraph 5-14
A2R68	X-GAIN CTR	5-15	2	Establishes range of front-panel X- and Y-Gain control
A2R24	Y-GAIN CTR		3	
A2R74	X HF ADJ 1	5-16	2	X-axis output pulse response adjustments
A2C27	X HF ADJ 2			
A2C28	X HF ADJ 3			
A2R30	Y HF ADJ 1	5-16	3	Y-axis output pulse response adjustment
A2C11	Y HF ADJ 2			
A2C10	Y HF ADJ 3			
A1R34	HF ADJ NO. 1	5-17	4	Z-axis output pulse response adjustment
A1C8	HF ADJ NO. 2			
A3R13	FOCUS LIM	5-17	5	Sets range of front-panel FOCUS control
A1R11	Z-axis Gain			Intensity level
A2C18	+X ATTEN COMP	5-18	2	AC Compensation for 5 V or 10 V attenuator ranges
A2C19	—X ATTEN COMP		2	
A2C1	+Y ATTEN COMP		3	
A2C2	—Y ATTEN COMP		3	
A1C1	+Z ATTEN COMP		4	
A1C2	—Z ATTEN COMP		4	
A1R77	ORTHO ADJ	5-19	5	Adjusts the angle between horizontal and vertical axes
A1R79	PATTERN ADJ	5-19	6	Eliminates bowing of trace

Table 5-2. Condensed Adjustment Procedures (Cont'd)

Adjustment	Procedure
X GAIN CTR, A2R68 Y GAIN CTR, A2R24	1. Set front-panel X-GAIN and Y-GAIN controls fully clockwise. 2. Apply 1 kHz square wave with amplitude of 0.8 V p-p to either X or Y input. 3. Adjust X GAIN CTR (A2R68) or Y-GAIN CTR (A2R24) for 96 mm deflection.
X HF ADJ 1, A2R30 X HF ADJ 2, A2C27 X HF ADJ 3, A2C28	1. Apply 100 kHz sawtooth signal to Y input (full-screen deflection). 2. Apply ≈400 kHz square wave to X input (full-screen deflection). 3. Adjust A2R74, A2C27, and A2C28 so displayed waveform has fast transition, sharp corners, and flat tops.
Y HF ADJ 1, A2R30 Y HF ADJ 2, A2C11 Y HF ADJ 3, A2C10	1. Apply 100 kHz sawtooth signal to X input (full-screen deflection). 2. Apply ≈400 kHz square wave to Y input (full-screen deflection). 3. Adjust A2R30, A2C11, and A2C10 so displayed waveform has fast transition, sharp corners, and flat tops.
Z-AXIS AMPL ADJ HF ADJ NO. 1, A1R34 HF ADJ NO. 2, A1C8 FOCUS LIM, A3R13	1. With front-panel FOCUS control defocus spot. 2. Connect monitor oscilloscope to test point collector of A1Q13 through 10:1 divider probe. 3. Apply 0.5 V p-p 400 kHz square wave to Z-amplifier input. 4. Adjust front-panel INTENSITY control so waveform observed on oscilloscope does not limit at top or bottom. 5. Adjust A1R34 and A1C8 for fast-rise response, consistent with sharp corners and minimum overshoot. 6. Set front-panel FOCUS control to midrange. 7. Adjust A3R13 for smallest spot on CRT.
+X ATTEN COMP, A2C18 —X ATTEN COMP, A2C19 +Y ATTEN COMP, A2C1 —Y ATTEN COMP, A2C2 +Z ATTEN COMP, A1C1 —Z ATTEN COMP, A1C2 (OPTION 100, 101, 200, 201)	1. Set appropriate attenuator for 5 V or 10 V range. 2. Apply 10 kHz square wave, 5 V (10 V) p-p signal to appropriate amplifier. 3. Connect monitor oscilloscope to output of appropriate amplifier. 4. Adjust appropriate attenuator compensation capacitor for best square-wave response on oscilloscope.
ORTHO ADJ, A1R77	1. Apply sine-wave signal to X-amplifier input. 2. Adjust TR ALIGN for horizontal trace. 3. Accomplish step 1 for Y-amplifier, using A1R77 to adjust trace vertically.
PATTERN A1R79	1. Apply sine-wave to X and Y inputs. 2. Adjust pattern, A1R79 for straight non-bowed trace at top, bottom, left and right edges of screen.

HEWLETT-PACKARD
X-Y DISPLAY MODEL 1332
HIGH VOLTAGE AND BLANKING MODIFICATIONS

*REMOVE R32 (39 OHM)

*USE 3/16" DRILL TO ISOLATE A1U5 PIN 5 FROM GROUND PLANE, COMPONENT SIDE

*CUT TRACE SIDE TRACE FROM TTL BLANK INPUT TO A1U5 PIN 8

*INSTALL JUMPER, BACKSIDE BOARD BETWEEN A1U5 PINS 4+8

*INSTALL JUMPER AND R75 (1K) ON BACKSIDE FROM A1U5 PIN 5 TO TTL BLANK (PHOTO TAKEN)

*INSTALL FOLLOWING:

1-UR-7	10 V ZENER - IN5240
1-CR-26	IN914
1-R-85	22K 1/4W
1-R-86	33K 1/4W
1-R-87	8.2K 1/4W
2-C41,42	.01UF 100V
1-U5-74LS02	

FOR GAMMA OPTION:
REMOVE R26 (619 OHM)
INSTALL 1100 OHM 1/4W FOR R26
INSTALL 910 OHM FOR R28
INSTALL IN914 FOR CR5

-REMOVE INPUT AND OUTPUT WIRES, UNPLUG PC BOARD

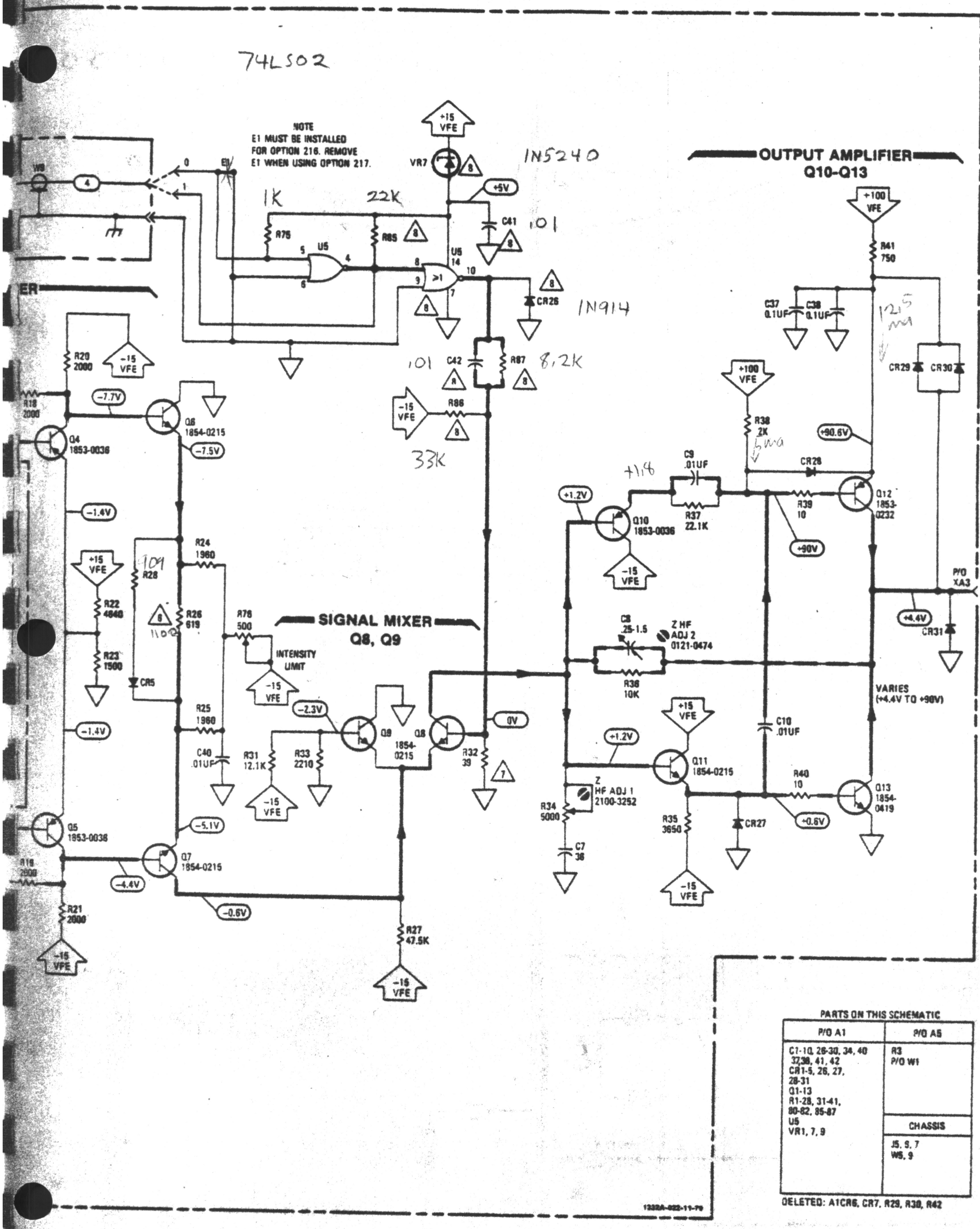
-REMOVE ALL 8 HEAT-SUNK OUTPUT TRANSISTORS CAREFULLY

-REMOVE 4 BLUE .1M 200V CAPACITORS AND REPLACE WITH .1M 500V CAPACITORS

-REMOVE 4 20K 1W RESISTORS AND REPLACE WITH 56K 1W RESISTORS

-REMOVE 4 PISTON CAP TRIMMERS

-REMOVE 6 - 43.2K 1W RESISTORS AND REPLACE WITH 180K 1W RESISTORS



PARTS ON THIS SCHEMATIC

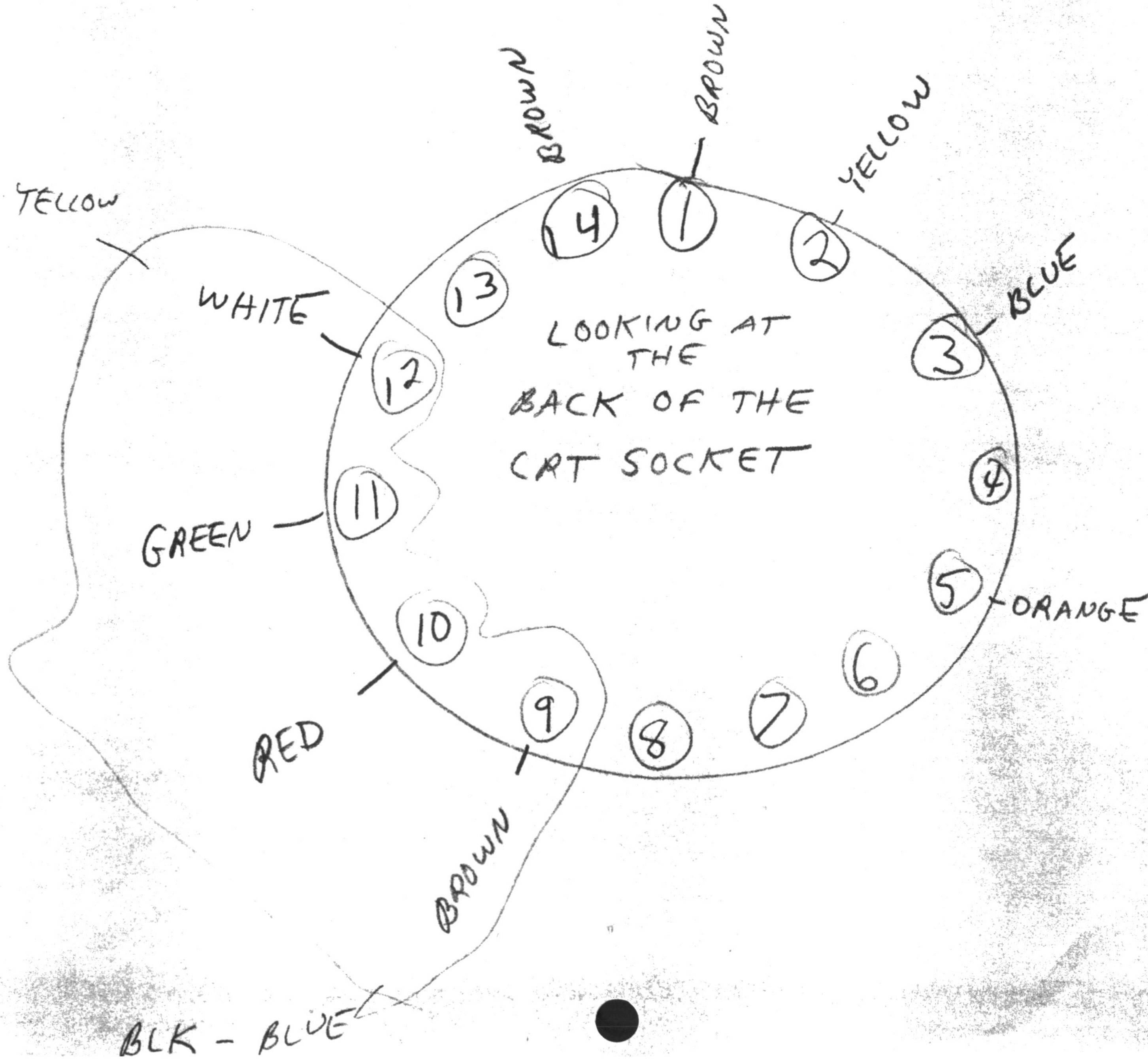
P/O A1	P/O A5
C7-10, 26-30, 34, 40 37,38, 41, 42 CR1-5, 26, 27, 28-31 Q1-13 R1-28, 31-41, 80-82, 85-87 U5 VR1, 7, 9	R3 P/O W1
	CHASSIS
	J5, 9, 7 W5, 9

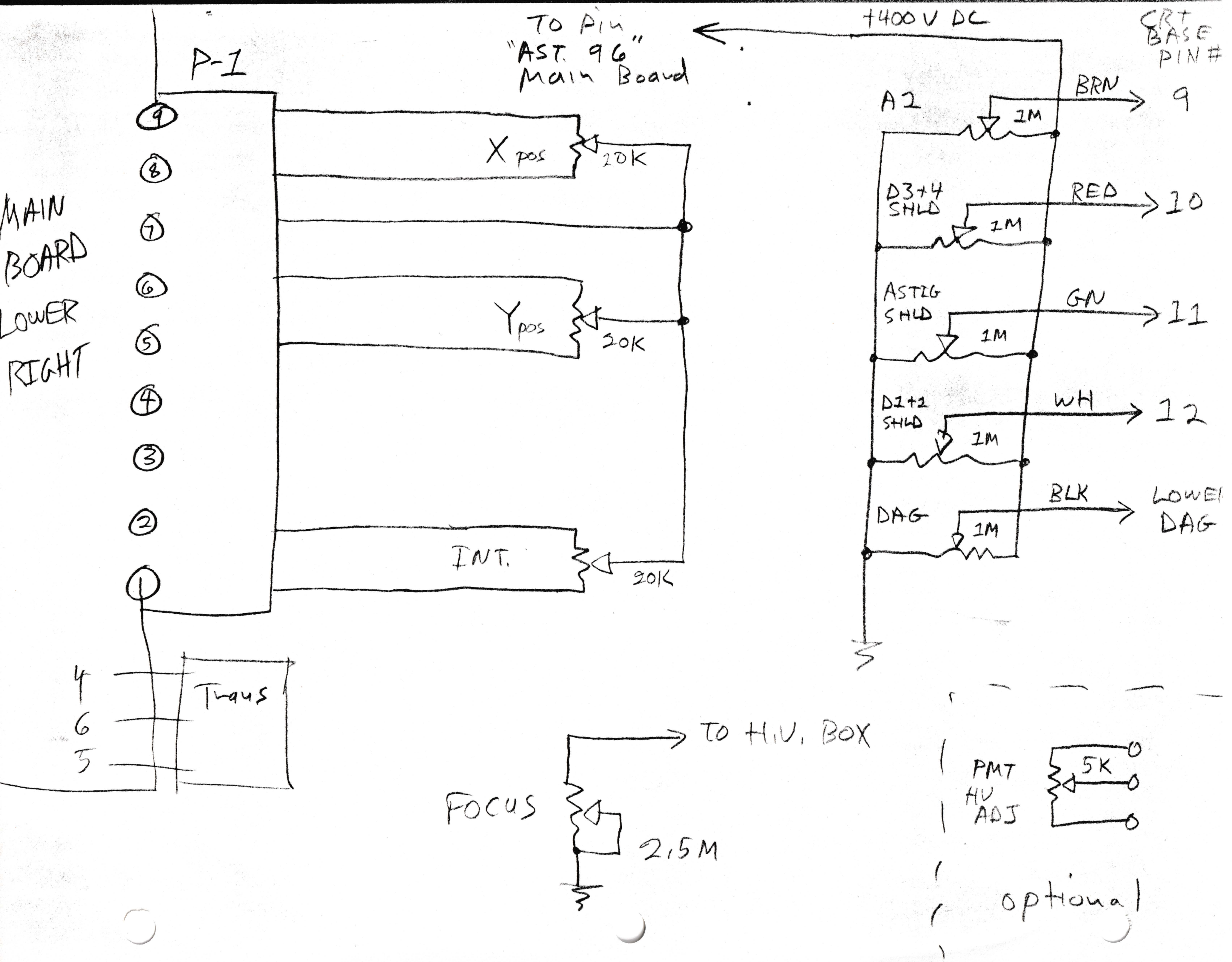
DELETED: A1CR6, CR7, R29, R30, R42

4

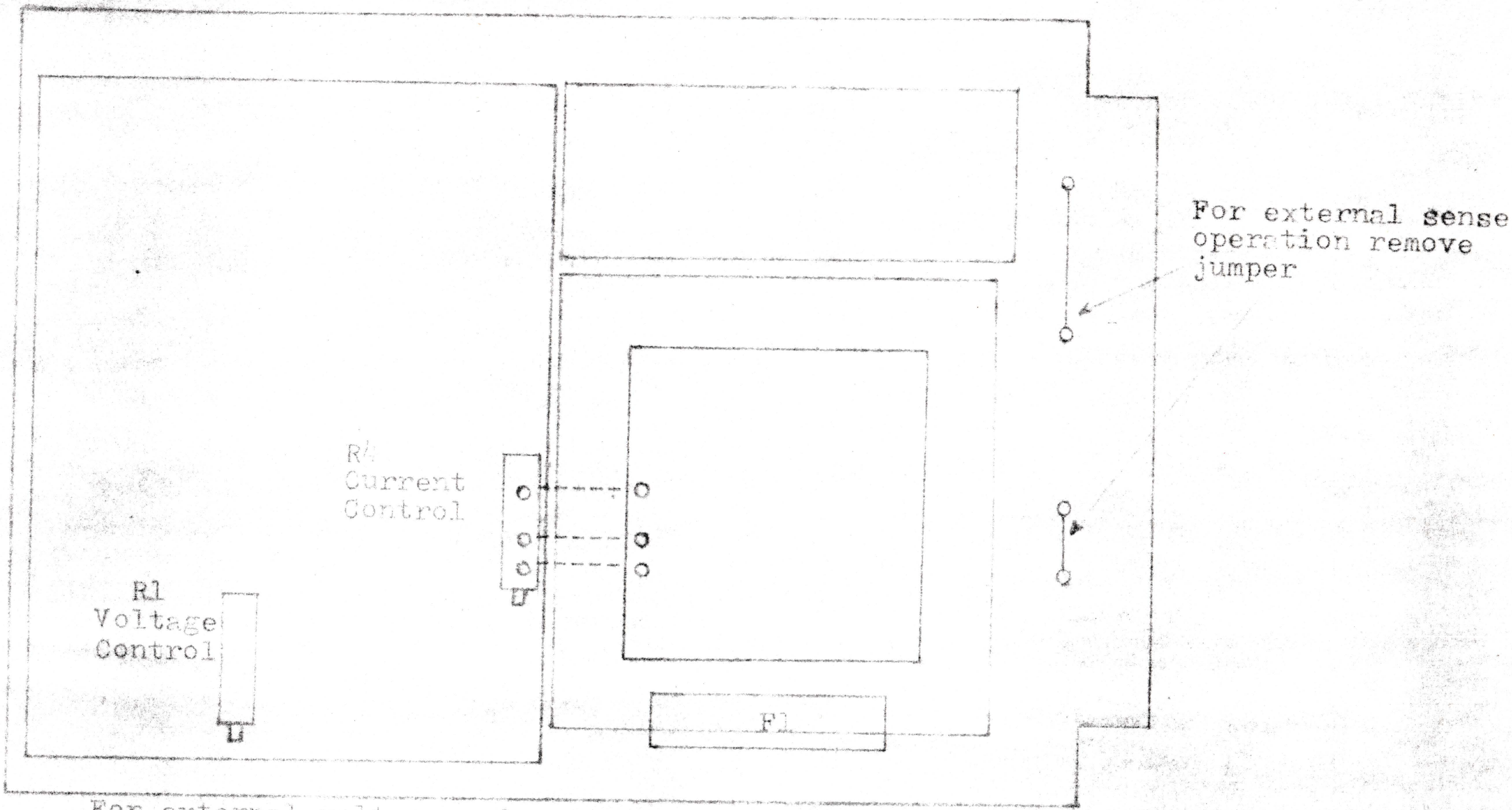
~~4332 XY Amp changes.~~

- Remove Input and output wires, unplug PC Board.
- Remove all 8 heat-sunk output transistors carefully
- Remove 4 blue .1M 200v capacitors and replace with .1M 500v capacitors.
- Remove 4 20K 1W resistors and Replace with 56K 1W RESISTORS
- Remove 4 piston cap trimmers.
- Remove 6 - 43,2K 1W resistors and replace with 180K 1W RESISTORS


LOOKING AT
THE
BACK OF THE
CRT SOCKET
1
2
3
4
5
6
7
8
9
10
11
12
13
14
BROWN
YELLOW
BLUE
ORANGE
BROWN
RED
GREEN
WHITE
YELLOW
BROWN
BLK - BLUE


P-1
TO Pin "AST. 96" Main Board
+400 V DC
CRT BASE PIN #
MAIN BOARD LOWER RIGHT
9
8
7
6
5
4
3
2
1
X pos
20K
Y pos
20K
INT.
20K
A2
1M
BRN
9
D3+4 SHLD
1M
RED
10
ASTIG SHLD
1M
GN
11
D1+2 SHLD
1M
WH
12
DAG
1M
BLK
LOWER DAG
4
6
5
Trans
TO H.V. BOX
FOCUS
2.5M
PMT HV ADJ
5K
optional

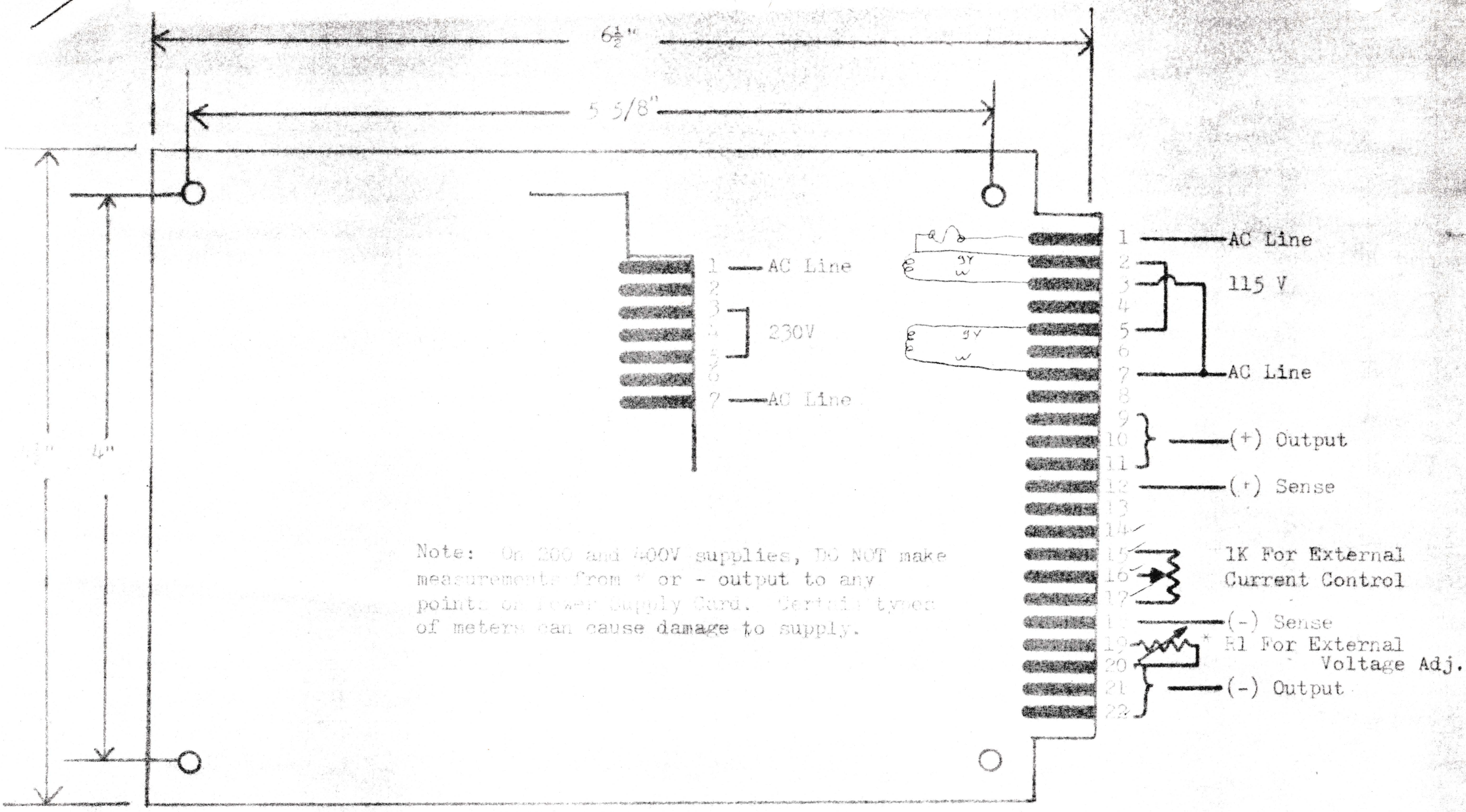
TOP VIEW



For external voltage and current control remove R1 & R4, install jumpers shown as dashed lines and connect control pots to contacts as shown on DWG. #1737

Note on 200 and 400V supplies Do Not make measurements from + or - output to any points on Power Supply Card. Certain types of Meters can cause damage to supply.

TITLE POWER SUPPLY CONSTANT VOLTAGE CONSTANT CURRENT MODEL PC400-.o2EM Dual Primary		HOPE ELECTRONICS P.O. BOX 684 285 CHANGEBRIDGE ROAD PINE BROOK, N.J. 07058		
DRAWN	DATE 3-11-77	SIZE	DRAWING NUMBER	ISSUE
CHECKED	DATE		1736	
APPROVED	DATE			



BOTTOM VIEW

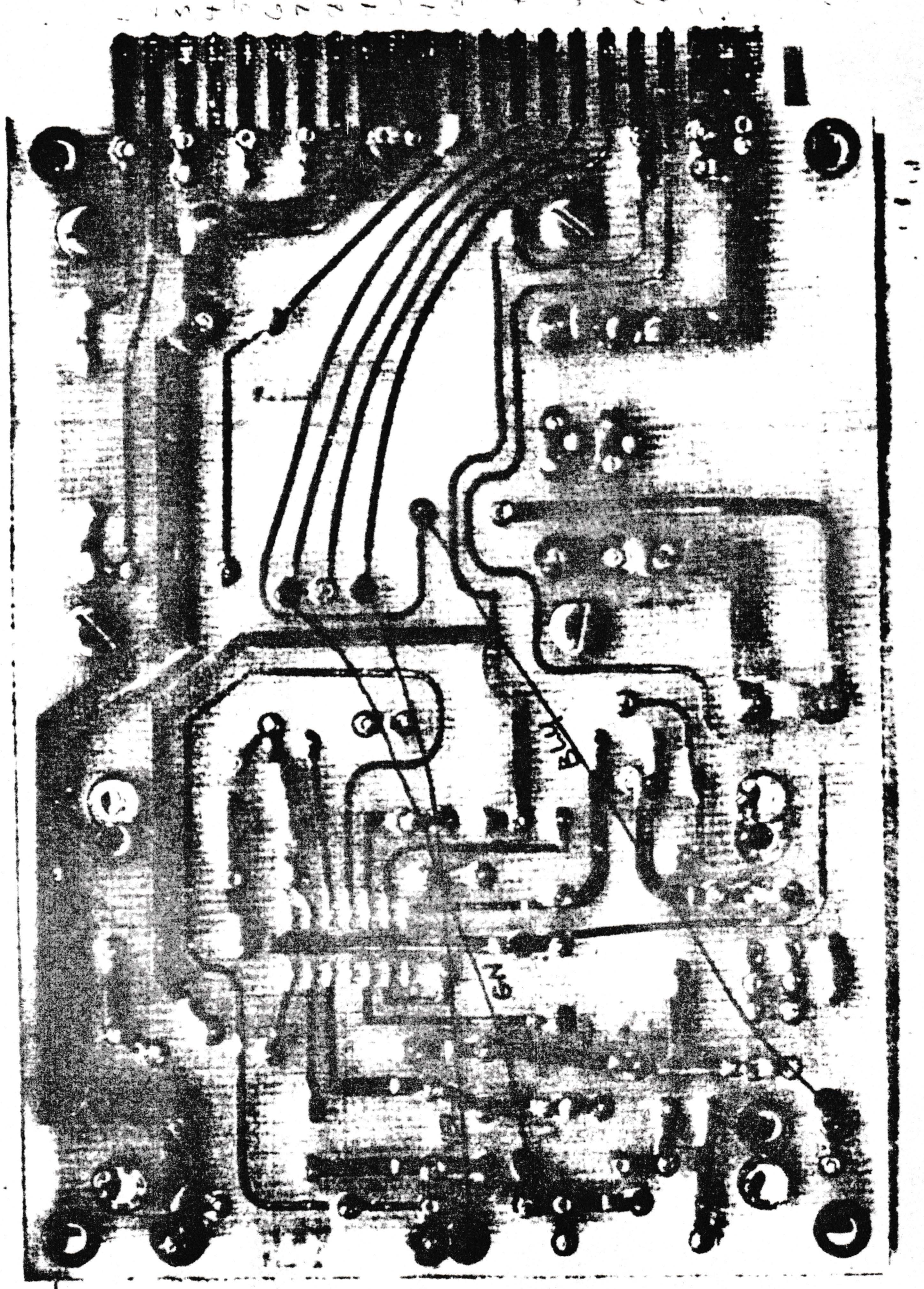
MODEL	*R1
PC15-1EM	15K
PC30-.5EM	30K
PC50-.2EM	50K
PC100-.1EM	100K
PC200-.05EM	200K
PC400-.02EM	400K

TITLE POWER SUPPLY
CONSTANT VOLTAGE
CONSTANT CURRENT
MODEL PC400-.02EM Dual Primary

HOPE ELECTRONICS
P.O. BOX 684
285 CHANCEBRIDGE ROAD
PINE BROOK, N.J. 07058

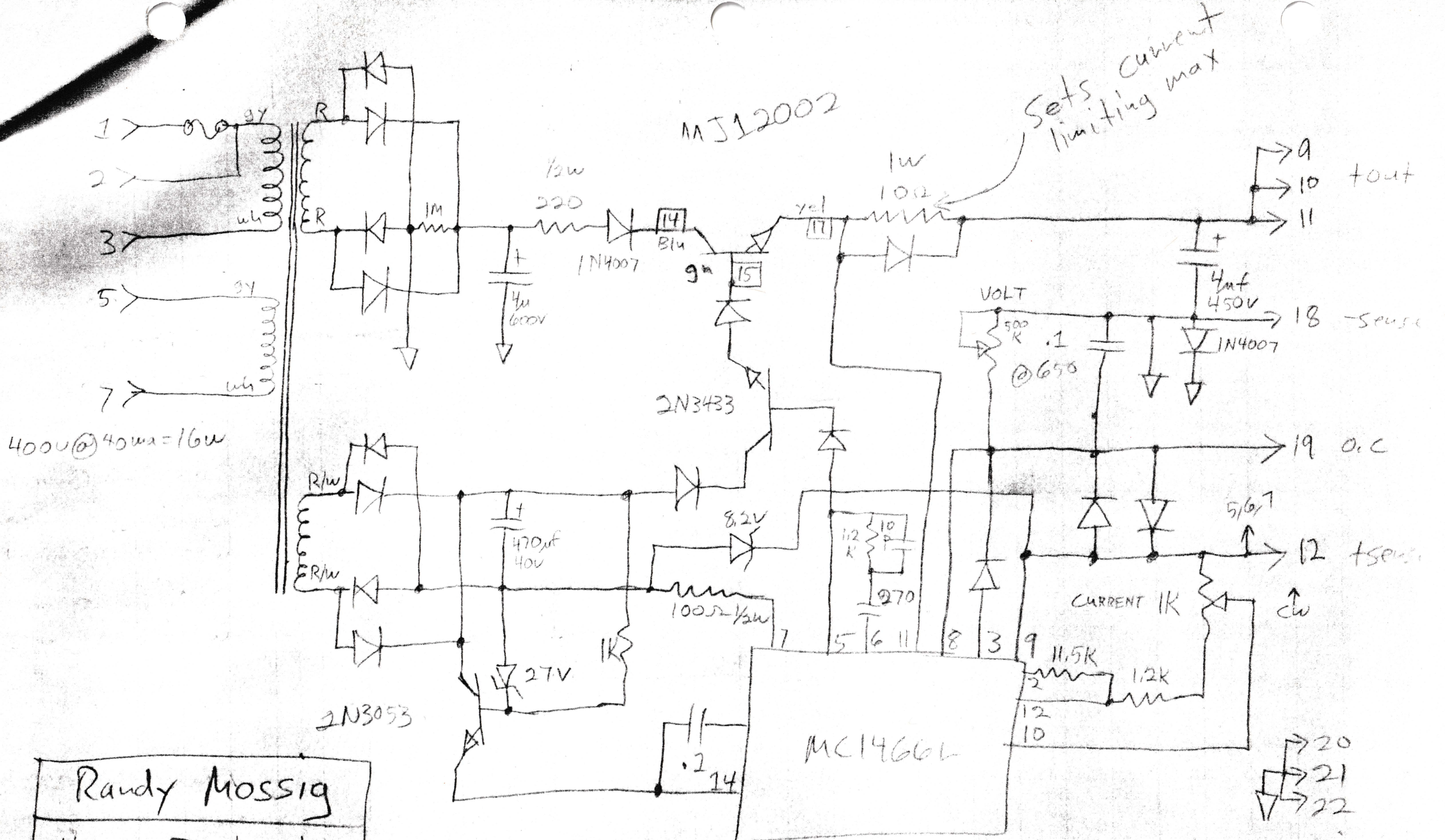
DRAWN — DATE 5-11-77
CHECKED MOD DWS — DATE 12/8/82
APPROVED — DATE

SIZE	DRAWING NUMBER	ISSUE
	1737	



ADD JUMPER

PC-400-.02EM
Modification
Figure 2



Randy Mossig

Hope Electronics

(201) 227-0099

Hope Electronics

PC 400-.02EM
with 40 ma mod.
DWS 12/8/82

AN-703
Application Note

DESIGNING DIGITALLY-CONTROLLED POWER SUPPLIES

Prepared by:
Don Aldridge
Neil Wellenstein

This application note shows two design approaches; a basic low voltage supply using an inexpensive MC1723 voltage regulator and a high current, high voltage, supply using the MC1466 floating regulator with optoelectronic isolation. Various circuit options are shown to allow the designer maximum flexibility in any application.

MOTOROLA Semiconductor Products Inc.

DESIGNING DIGITALLY-CONTROLLED POWER SUPPLIES

INTRODUCTION

The current trend in electronic instruments is toward digital control. The advantages of this technique are many; convenience, accuracy and personal appeal are just a few of these. In the past, these advantages were obtained at a rather high cost that limited its use to expensive laboratory instruments. Recent advances in integrated-circuit technology have helped eliminate this disadvantage. This applications note shows two of Motorola's monolithic digital-to-analog converters (DAC's) teamed with Motorola integrated-circuit voltage regulators to provide two digitally-programmable power supplies. The digitally-controlled power supply can be used for a programmable laboratory power supply, as a computer-controlled power supply for automated test equipment, or in industrial control systems. There are several circuit options allowing the designer flexibility to meet his particular needs.

One of these power supplies uses an MC1408L* 8-bit DAC coupled to an MC1723 regulator. It has a voltage range from 0 to 25.5 V in 0.1 V increments and it is capable of supplying currents in excess of 100 mA. This value can be extended with the addition of an external current-boost transistor.

The second power supply utilizes the MC1406L 6-bit DAC and the MC1466L floating voltage regulator to overcome the voltage and current limitations of the standard DAC's. The MC1406L DAC floats on the output voltage with the MC1466L regulator. The digital word is coupled into the DAC with Motorola 4N28 optoelectronic couplers, which allow the DAC to float as high as 500 V. The output voltage of the circuit, designed to supply up to 1 A and 63 V, may be incremented in 63 steps of 1 V each.

DAC Operation

The MC1406 and MC1408 are digital-to-analog converters that have 6- and 8-bit digital inputs, respectively. The inputs are TTL compatible and are converted to an analog output by means of an R-2R ladder network, reference current, and current switches. An R-2R ladder network is shown in Figure 1. At each node of the R-2R ladder the reference current is split in half. Fifty percent of the current continues on through the ladder while the other half is shunted into the ladder termination circuits. The currents that flow into the ladder termination circuits are summed together in the output or shunted to the positive supply, depending upon the digital inputs. The input is a digital word consisting of ones and zeros which turn the appropriate switches on or off. The output quantity is a unilateral current sink with the full scale current being set by an external resistor and reference voltage. Typically the reference current is set at about 2 mA, which means that the output will sink current from 0 to $\frac{63}{64}$ x 2 mA with 64 discrete levels for the MC1406, and from 0 to $\frac{255}{256}$ x 2 mA with 256 discrete levels for the MC1408. A single capacitor is used for compensation of the DAC.

(*) This series of DAC's is available with devices specified for 6, 7, or 8-bit accuracy. A suffix after the "L" in the device number indicates the specified accuracy.

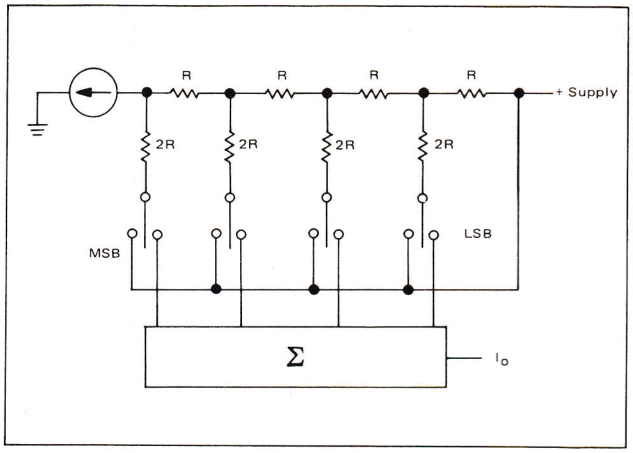


FIGURE 1 – R-2R Ladder Network

LOW VOLTAGE SUPPLY

Since the output of the MC1408L is a current sink, an operational amplifier is needed to convert from current to voltage, for the low voltage supply. In this particular application, the MC1723 voltage regulator was chosen because it contains the needed operational amplifier with a current capability in excess of 100 mA. In addition, this package has an internal 7 V reference which can be used as the reference supply for the MC1408. The MC1723 regulator is also quite inexpensive. The MC1408 and MC1723 combination, shown in Figure 2, requires two negative power supply voltages. One is a –5 V supply which is used for the MC1723, while the other negative supply is for the MC1408. Minus 15 V is a typical supply value for the MC1408, although this can be less if convenient. However, it should be at least 3 V greater in magnitude than the negative supply for the regulator. The

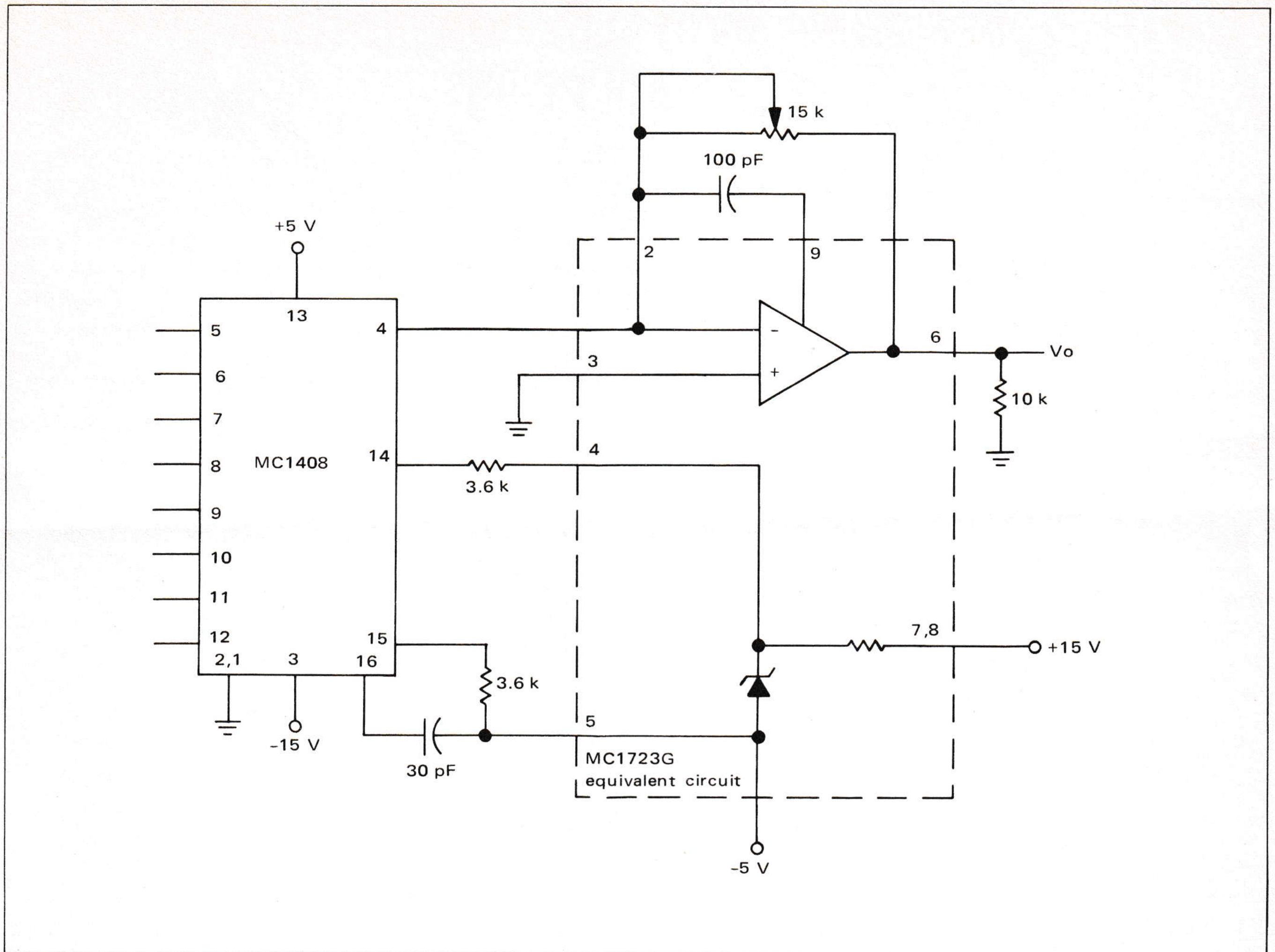


FIGURE 2 — 8-Bit DAC With Voltage Regulator

-5 V supply does not require a high degree of regulation, and it can be obtained from a resistor divider network off the -15 V supply. The 15 kohm trimpot is used for calibration of the output voltage. The calibration should be done for the maximum output voltage.

Two positive voltages are also required for operation. One is a 5 V supply needed for the MC1408, which is usually available from other TTL power supplies. The second is the voltage to be regulated by the MC1723, which should be at least 3 V above the maximum output voltage required. To take advantage of the entire range of the MC1408, to 25.5 V with 0.1 volt increments, 28.5 V would be required for this supply. One method for obtaining the required voltages for the supply is shown in Figure 3. This technique uses the MC1468 ±15 V regulator, for the ±15 V, and an MLM109 5 V regulator for the logic and DAC supply.

At this point, we have a digitally-controlled power supply with binary inputs and an output current rating of 100 mA. The output of the MC1723 can be current-boosted to provide the desired output current range. Figure 4 shows a current-boost technique for a 2 A programmable power supply. Other current-boost configurations can be found on the Motorola MC1723 data sheet.

Accuracy, Regulation and Settling Time

The MC1408 is accurate to 1/2 of the least significant bit. The power supply is set up so that the least significant bit is 0.1 V which gives an accuracy of ±0.05 V. The amplifier in the MC1723 is essentially being operated in the unity gain mode over the entire output range; this implies a constant output impedance over the entire voltage range. The output impedance is about 30 milliohm. Line regulation remains about the same as with the MC1723 in a normal configuration. Settling time for a 20 V swing for the MC1723, without current-boost, is less than 5 μsec.

HIGH VOLTAGE SUPPLY

The second power supply uses the MC1466 as the regulator and the MC1406 for the DAC. The MC1408 can also be used if more resolution is needed. This supply provides a programmed high voltage output, in this case up to 63 V.

MC1466L Operation

The MC1466L regulator is unique in that it operates from a separate, 25 Vdc supply floating on the output voltage which may be as high as desired. The output

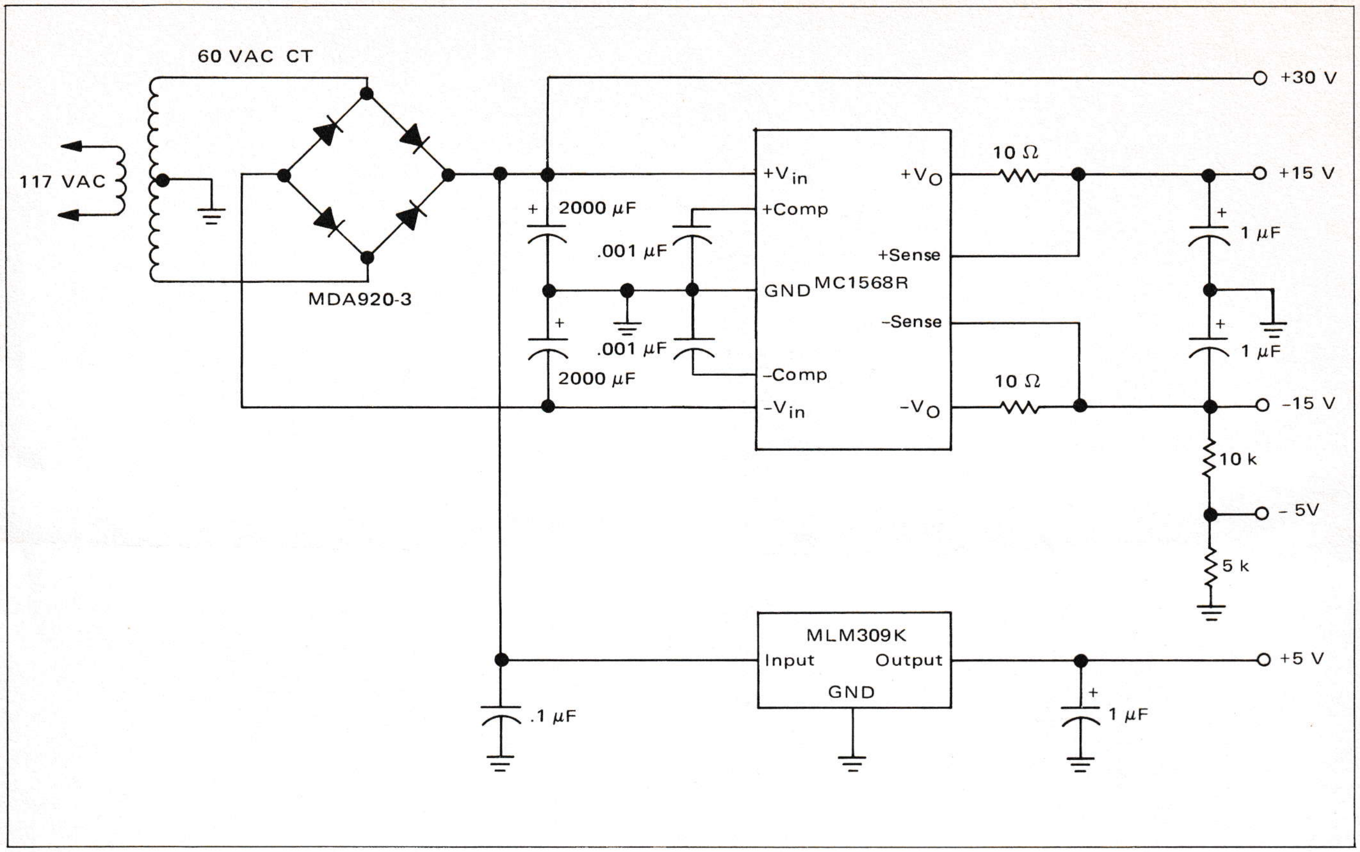


FIGURE 3 – Supply Voltage For Digitally-Controlled Low Voltage Power Supply

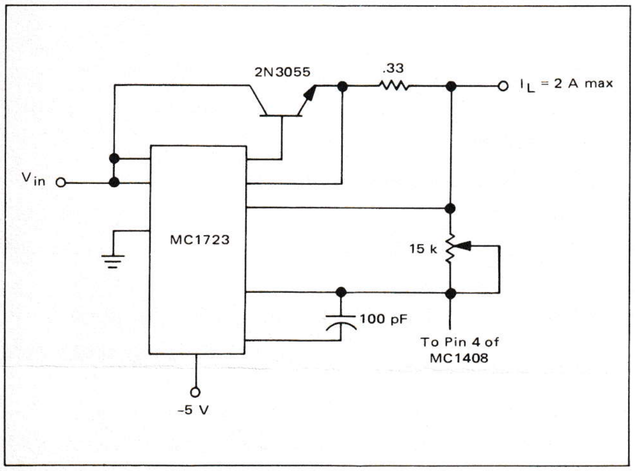


FIGURE 4 – Current-Boosted MC1723 Voltage Regulator

voltage range is limited only by the capability of the external pass transistors and, in this application, by the voltage rating of the optoelectronic couplers.

The regulated output voltage is established as shown in Figure 5. A reference current (I_1), normally 1 mA, is passed to ground through a voltage setting resistor (R_{SET}). This technique establishes a reference voltage which is applied to the non-inverting input of a differential amplifier. The inverting input of the amplifier is connected to the regulated output in a voltage follower configuration, thus assuring that the output voltage is equal to the reference voltage. If the reference voltage is varied by changing either I_1 or R_{SET}, the output voltage changes accordingly.

Optoelectronic Couplers

The 4N28 optoelectronic coupler is a NPN phototransistor and a gallium-arsenide infrared LED packaged so that they are optically coupled, but electrically isolated. Breakdown voltage between the phototransistor and the LED is 500 V, minimum. Current transfer ratio between the LED current and the transistor collector current is typically 30%, with a 10% minimum. The maximum current for the MC1406L digital input logic "0" level is 1.5 mA. Therefore, 15 mA of current through the LED assures a logic "0" at the MC1406L input, even at the minimum transfer ratio. The 15 mA diode current is also within the current-sink capability of standard TTL gates, which may be used to drive the diodes.

If higher breakdown voltages or current transfer ratios are needed in a particular application, other couplers are available. For example, the Motorola 4N25 exhibits a breakdown voltage rating of 2500 V and a 20% minimum transfer efficiency.

Circuit Operation

Since the MC1466L output voltage is set by means of a current through a resistor and the MC1406L output sinks current in proportion to a digital word input, combining the two in a digitally-controlled voltage source should work quite well. However, in order to work together, the MC1406L must float with the MC1466L on the output voltage. The MC1406L is, therefore, powered from the 25 Vdc supply that powers the MC1466L.

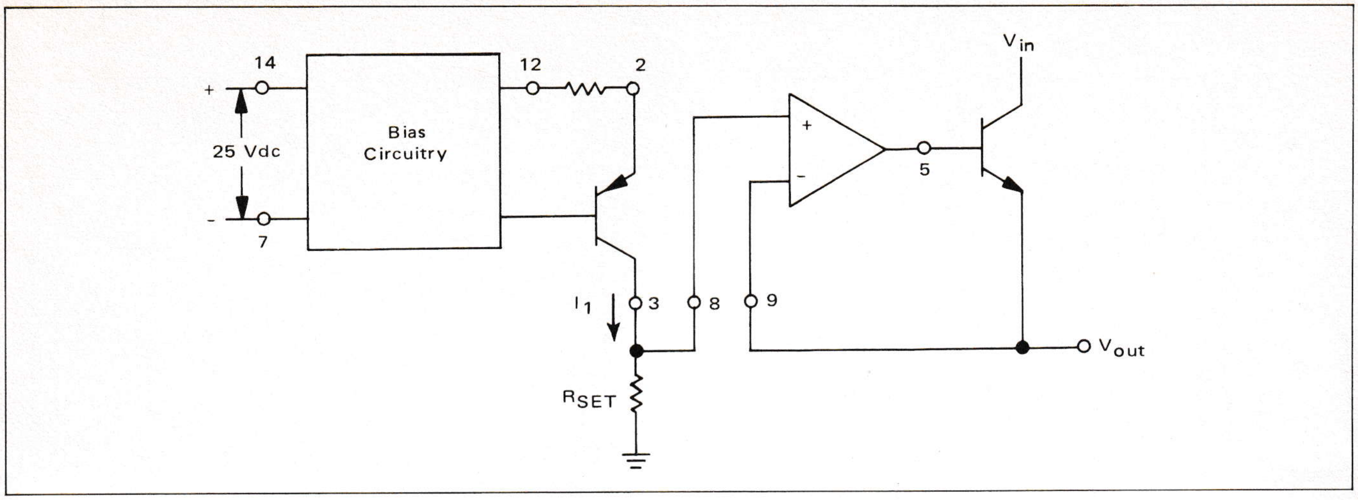


FIGURE 5 – Block Diagram of MC1466L Voltage Regulator

Circuit operation may be explained by referring to the block diagram in Figure 6. I_1 is established at 1 mA by a current source in the MC1466L. The output of the MC1406L, current I_2, is programmed from 0 to 1 mA by the digital word coupled into the MC1406L through the 4N28 optical couplers. When I_2 is 0, I_3 is 1 mA and the voltage developed across R_{SET} is at a maximum. As I_2 is increased, the current available for I_3 decreases and consequently the voltage across R_{SET} decreases. When I_2 equals 1 mA, the voltage across R_{SET} is zero. Since the MC1466L holds the output voltage, V_{out}, equal to the voltage developed across R_{SET}, V_{out} is programmable by programming I_2.

The complete circuit schematic, which appears in Figure 7, illustrates how the zero voltage reference for the MC1406L is established by the 1N5235, a 6.8 V zener diode. This approach places the MC1406L zero reference at approximately the same voltage level as established at pins 3, 8 and 9 on the MC1466L by an internal zener. Since the output voltage, pin 4, of the MC1406L must stay within 1 diode drop of its zero reference, and since pin 4 is connected to pins 3 and 8 of the MC1466L, the zener which establishes the MC1406L zero reference must match the MC1466L internal zener to within about ±0.5 V. This internal zener is CR1 on the MC1466L data sheet, nominally 7.25 V, which may be measured between pins 7 and 9. The positive supply voltage for the MC1406L is provided by the 1N5231, a 5.1 V zener. Reference current is established by the 1N827, a temperature-compensated 6.2 V zener reference diode, and a 5.76 kohm resistor in series with a 1 kohm trimpot. For less critical applications, the reference current could be derived from the 5.1 V positive supply zener or from pin 12 of the MC1466L.

The output voltage is established by the current through the 57.6 kohm, 1% resistor in series with the 10 kohm potentiometer R1. This resistor and potentiometer should both be temperature-stable because of the wide changes in power dissipation in these components as the voltage is programmed over its range. Maximum output current is adjustable by means of resistor R3 and may be set from near zero to over 1 A.

The digital inputs of the MC1406L have internal pull-

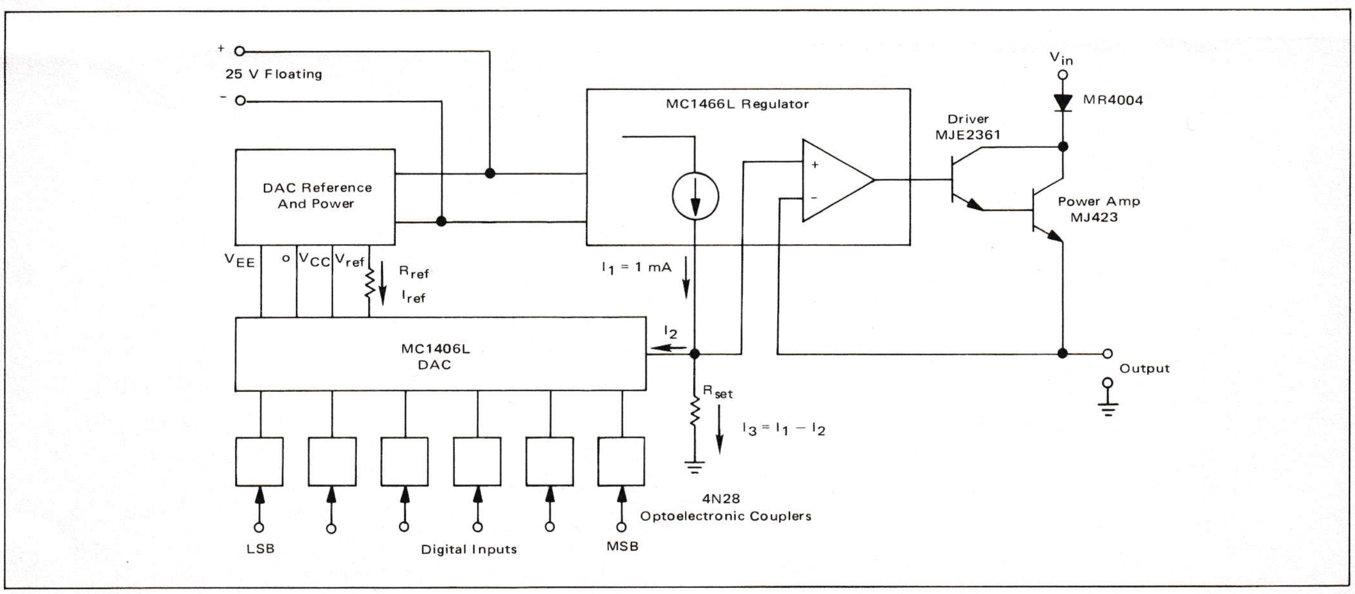


FIGURE 6 – High Voltage Supply Block Diagram

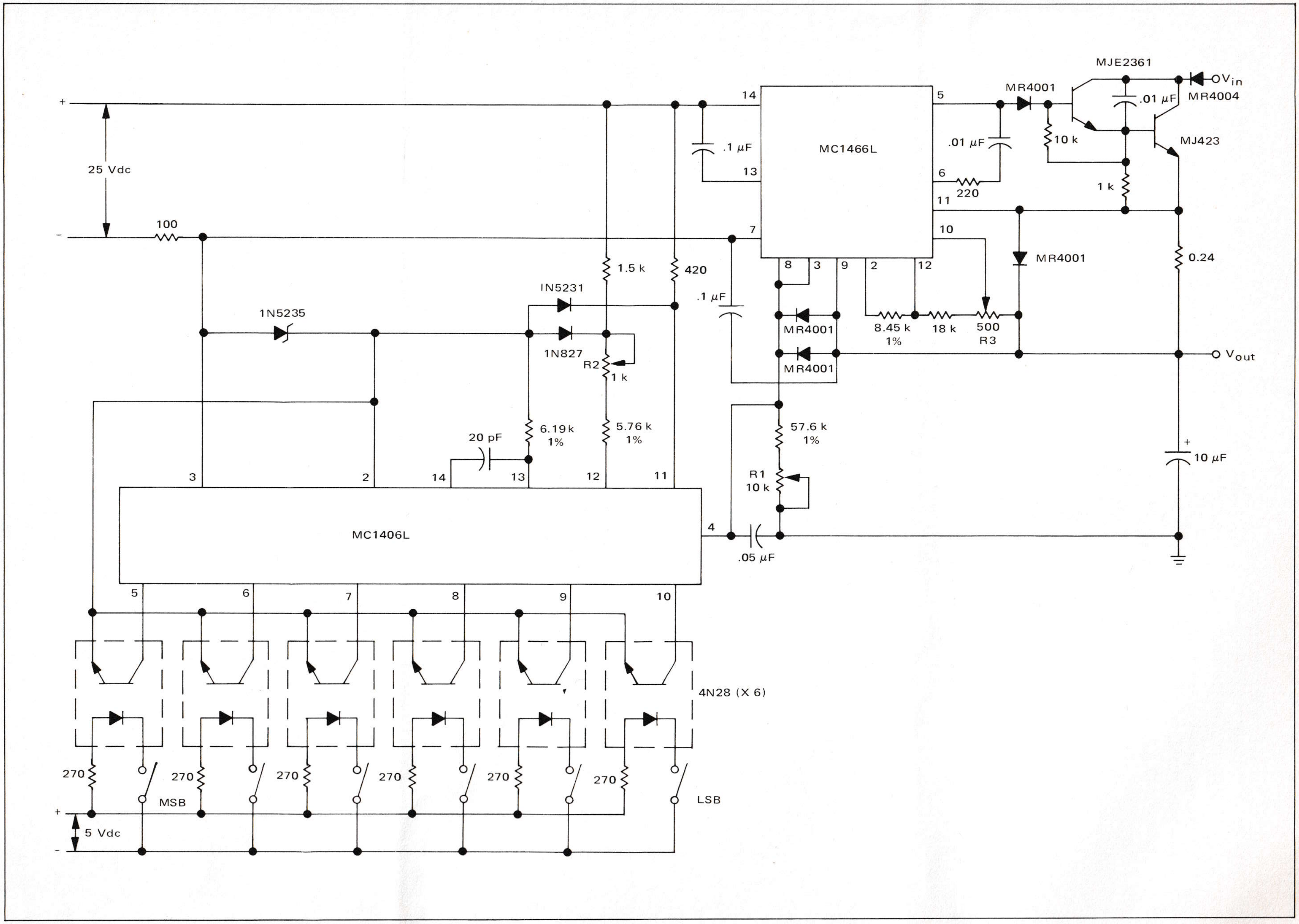


FIGURE 7 – High Voltage Power Supply Schematic

up resistors to the V_{CC} supply. This technique allows the collectors of the phototransistors in the 4N28 coupler to be connected directly to the digital inputs with no external pull-up resistors required. The emitters all are returned to the MC1406L zero reference at pin 2. The infrared LED current is about 15 mA when operated from a +5 V power supply, assuring that the phototransistor will be well saturated.

The current-amplifier output stage, consisting of the MJE2361 and the MJ423 in a Darlington connection, is designed to operate with a +70 V supply and deliver up to 1 A of load current over the full output voltage range of 0 to +63 V. The MJ423 must have a heat sink adequate to maintain the case temperature at +80°C while dissipating 70 W if operation at or near 0 V and 1 A output is expected, such as under short circuit conditions. Operation at higher output voltages is possible simply by increasing the size of resistor R_{ref} and increasing V_{in} accordingly. However, when this is done, care must be taken not to exceed the power dissipation ratings or the safe operating area curves of the MJE2361 and MJ423 transistors.

Adjustment and Performance

The digitally-controlled output voltage is initially set to +63.00 V by setting the digital inputs to all "0s" (switches closed) and adjusting the 10 kohm trimpot R1. Set all the digital inputs to "1s" (switches open) and adjust the output to zero volts with resistor R2. This adjustment should be done with the output loaded rather than open or leakage currents may affect the accuracy of the zero setting. The output voltage should now remain within ±0.5 V of its programmed value over the entire operating range of 0 to +63 V. Best overall accuracy may be obtained by checking each of the 6-bits to see which has the greatest error and trimming resistor R2 to split this error with the other bits.

An output filter capacitor is necessary for stability and good load transient response. Minimum value should not be less than 1 μF. Large capacitors will begin to degrade the output voltage slew rate, as shown in Table I. Table I shows the output voltage rise and fall times when the most significant bit is switched with a 100 ohm load resistor and 3 different output filter capacitors.

The regulation of V_{in} has virtually no effect on output voltage. However, regulation of the floating 25 Vdc does have an effect, as shown in Table II for a ±10% change in the 25 Vdc supply.

By simply changing one resistor, R_{SET}, the maximum

TABLE I

Output Voltage Rise and Fall Times

	OUTPUT CAPACITOR $R_L = 100\ \Omega$		
	1 μF	10 μF	100 μF
t_r (3.2 V to 28.8 V)	7-ms	8-ms	10-ms
t_f (28.8 V to 3.2 V)	8-ms	9-ms	30-ms

TABLE II

Output Voltages for Variations in Isolated Supply Voltage

22.5-V	25.0-V	27.5-V
63.00	63.00	63.00
31.10	31.00	30.93
3.37	3.17	3.02
1.41	1.20	1.05

output voltage may be set anywhere desired, up to the limits of the available power supply, series pass transistors and optical couplers used. Another possible variation is to set the reference current I_1 from the MC1466L to twice the maximum I_2 of the MC1406, either by doubling the current from the MC1466L or halving the MC1406L reference current into pin 12 of the MC1406L. This would allow twice the resolution over half the output voltage range, for example, from +31.5 V to +63 V in 0.5 V steps.

The MC1408L, an 8-bit monolithic DAC, offers 4 times the resolution of the 6-bit MC1406L. Using the MC1408L, the output voltage could be programmed to +255 V in 1 V steps. The MC1408L functions in the same manner as the MC1406L except that the input logic is inverted. With the MC1408L, maximum output voltage occurs with a logic "1" (switches open) applied to the 4N28 opto-electronic coupler.

Combining a monolithic DAC, a floating regulator, and optical couplers, provides a high-voltage/high-current 6-bit DAC which may be easily tailored by the user to suit specific requirements.

CIRCUIT OPTIONS

BCD-To-Binary Conversion

To allow convenient operation of laboratory programmable power supplies by human operators, a decimal system is needed at the input. Since the MC1408L and MC1406L exhibit binary inputs, an interface stage is needed to convert from a decimal system to the binary required by the DACs. By incorporating an intermediate stage of BCD format, thumbwheel switches with a BCD output can be used. Thus an interface circuit to convert the BCD-to-Binary code is required. Figure 8 shows a BCD-to-Binary converter, which uses the CMOS MC14008 binary adders. The range of the converter is that of an 8-bit DAC which is from 0 to 255 V. Each BCD input code is converted to the corresponding binary number by means of binary adders. For example, the BCD input with a value of 40 is converted to a binary 40 which consists of 32 plus 8. Likewise the BCD number 80 is converted to 64 plus 16. The MC14008 is a 4-bit binary adder which has carry in and carry out terminals. A separate adder is needed for a third level of addition. The last adder in IC4 is used for this since there can be no carry out from the previous stage.

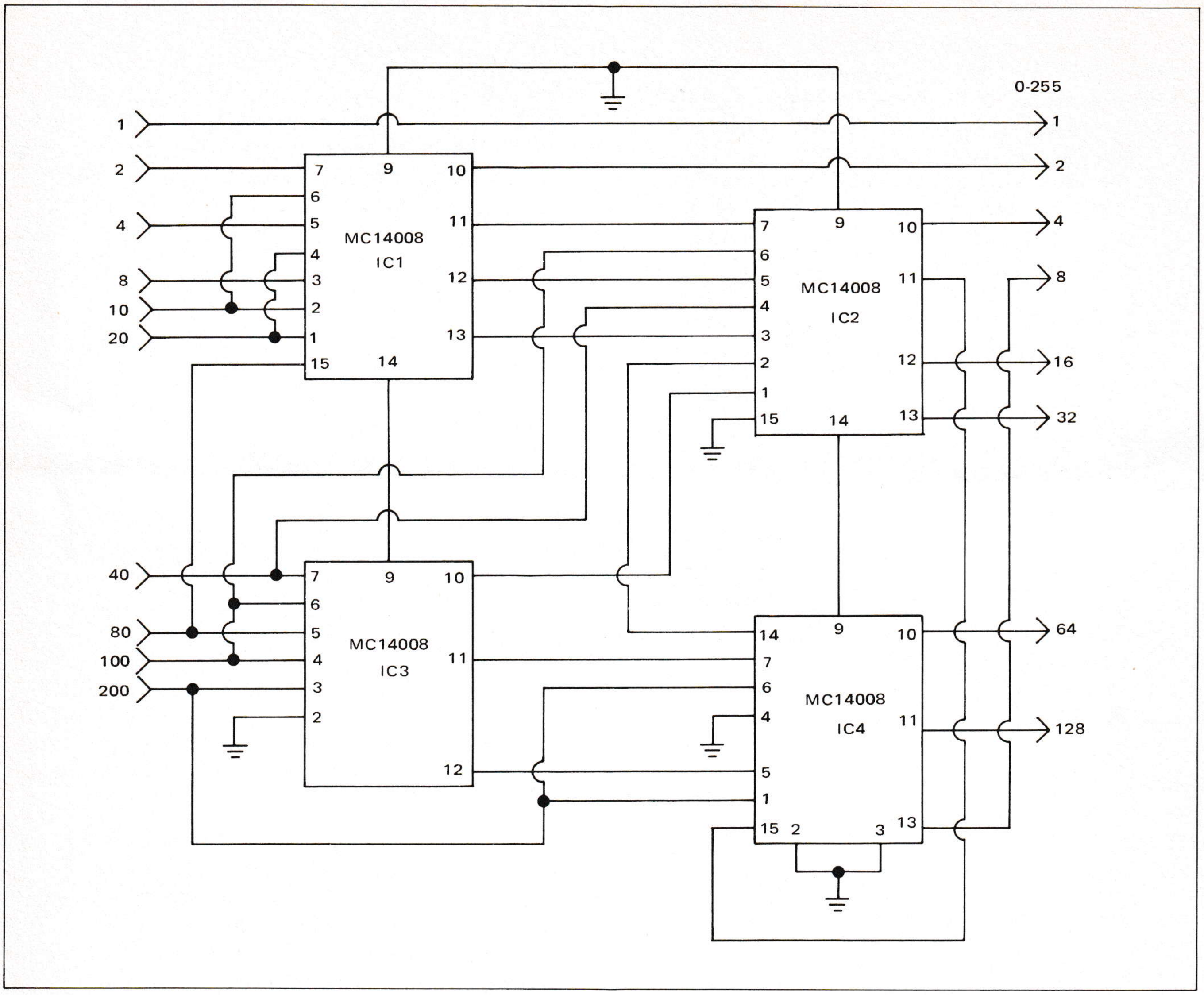


FIGURE 8 – CMOS BCD-To-Binary Converter

Memory Option

For applications where the digital inputs to the power supply are only available momentarily, or the inputs are to be changed while the output is to remain constant, a memory can be used to store the controlling information. An attractive memory can be made from a single CMOS MC14508, dual 4-bit latches. The block diagram of the DAC with latches is shown in Figure 9, Each of the inputs to the D/A converter is connected to the input signal through the latches. The strobe line of the latch controls the flow of data to the D/A inputs. With a logic "1" on the strobe line, the output will follow the inputs. When the strobe goes to a logic "0" the output retains the state of the data inputs at the time of the transition.

This memory option can be used for both the computer-controlled power supply and the laboratory supply. For the laboratory supply, the advantages of this method are apparent when the voltage is set to 9.9 V and the operator wishes to go directly to 10.0 V. Without the series of latches the output voltage would have to be returned to zero and then changed to the desired 10.0 V, and then this final value transferred to the DAC.

System Isolation

Another requirement for the computer-controlled or remotely-operated power supply is that of isolation between the systems. One of the newest methods to meet this requirement is with photon-coupled isolation to eliminate unwanted ground paths between the computer or controller and the system being controlled.

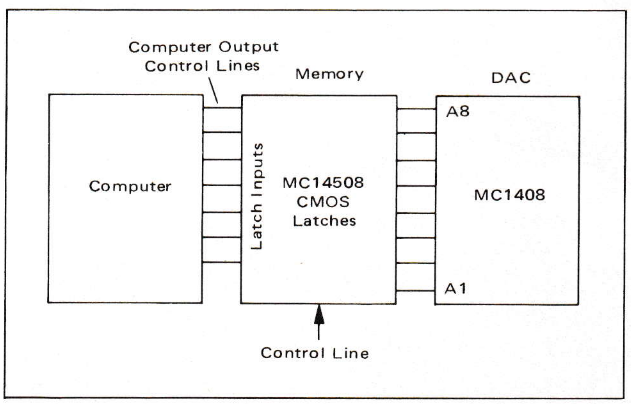


FIGURE 9 – CMOS Memory System For Programmable Power Supply

Motorola's 4N25-4N28 series of optoelectronic couplers may be used for this purpose to provide up to 2500 V of isolation between programmable supply and the remote driving equipment. The photon-coupled isolators must be used with the high voltage supply, since the inputs to the MC1406 are floating on the output voltage.

The MC1408 DAC is TTL/CMOS compatible. When CMOS IC's are used with the MC1406, or with the MC1408 through photon-coupled isolation, a buffer must be used to supply or sink the required current. This buffer can be either a CMOS MC14009, an inverting buffer, or an MC14010 non-inverting buffer. There are 6 buffers per package, each of which is capable of sinking 8 mA at V_{OL} = 0.5 V. An interface circuit for CMOS IC's through the 4N27 optoelectronic coupler provides 1500 V of isolation to a DAC is shown in Figure 10.

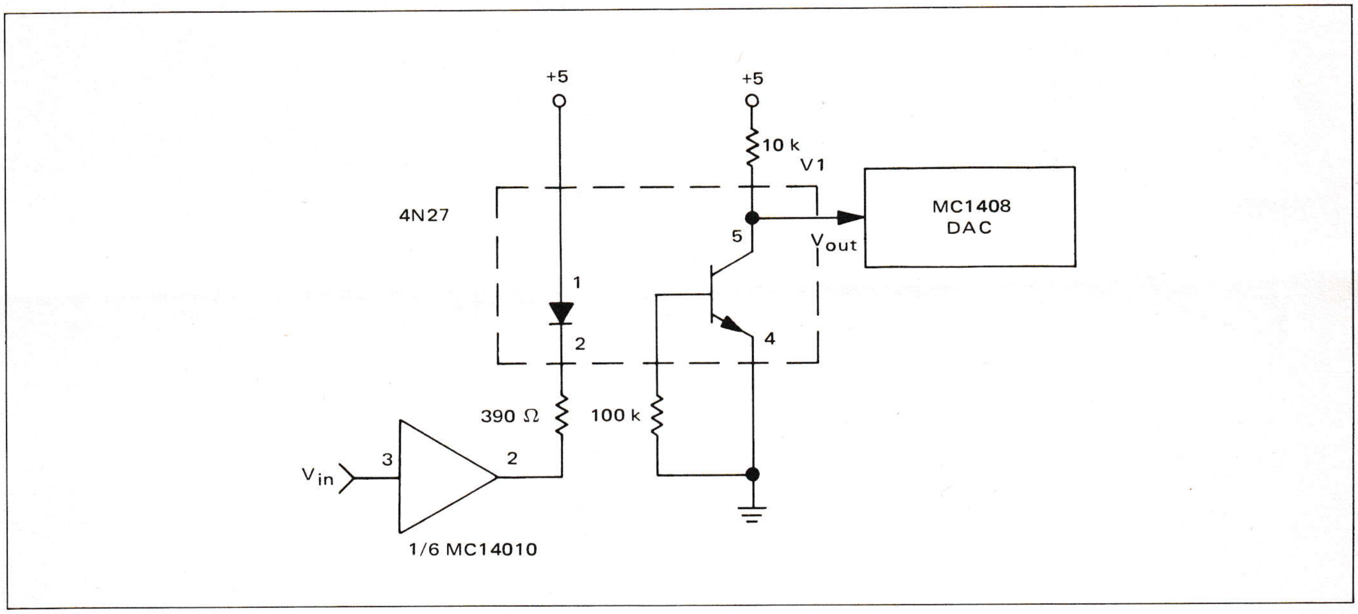


FIGURE 10 – Conversion of CMOS-To-Opto-To-DAC

CONCLUSION

The digitally-controlled power supply finds wide application in automated test equipment, computer-controlled systems, and laboratory power supplies. By making use of Motorola's low cost monolithic digital-to-analog converters and voltage regulators, the designer can now employ this useful building block in many applications where before it has not been economically feasible.

This application note has shown two design approaches; a basic low voltage supply using an inexpensive MC1723 voltage regulator and a high current, high voltage, supply using the MC1466 floating regulator with optoelectronic isolation. Various circuit options are shown to allow the designer maximum flexibility in any application.

MOTOROLA Semiconductor Products Inc.

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8517-1 PRINTED IN USA 7-75 IMPERIAL LITHO B51816 10M

AN-703

COHU ART CAM MODS

*PROBLEM: DEFL BD.

SOLUTION: EDGE CONN #103 TO TOP OF R1:

```
                             ____________________
                                      TOP        \
                                     RIGHT        |
                                                  |
                                                   \______
                                                          \
                                                  ==========|
                                                            |
                                                  ==========|
                                  CH                        |
         O------------------------------------------==========| 103
      ___|___                                               |
     |       |                                    ==========|
     |   R   |                     CV              ---------<
     |   1   |               -----------------------==========| 105
     |_______|                                              |
         |                                        ==========|
         O                                                  |
```

---LIFT BOTTOM OF R31. CONNECT TO BOTTOM OF R28:

```
           |           |
        ___|___     ___|___
       |       |   |       |
       |   R   |   |   R   |
       |   3   |   |   2   |
       |   1   |   |   8   |
       |_______|   |_______|
           |           |
           |-----------@
                       |
                       O
```

---REMOVE C2 NEAR TP-2.

---EDGE CONNECTOR 105 TO C2 HOLE NEAR TP2.

---ADD RED MOD STICKER.

*PROBLEM: BLANKING BD.

SOLUTION: LIFT + SIDE OF C4. EDGE CONNECTOR #104 TO + SIDE OF C4:

```
                                 ____________________
                                           TOP       \
                                          RIGHT       |
                                                      |
                                                       \_______
                                                               \
                                                      =========|
                  __________                                   |
          O    ___|  + C4   |___                      =========|
              /   |_________|   \                              |
             |                                        =========|
             |                                                 |
              \___@_______________________________=========|  104
                                                               |
                                                      =========|
                                                               |
                                                      =========|
                                                        _______<
                                                      =========|
                                                               |
        ---ADD MOD STICKER.                                    |
                                                               |
```

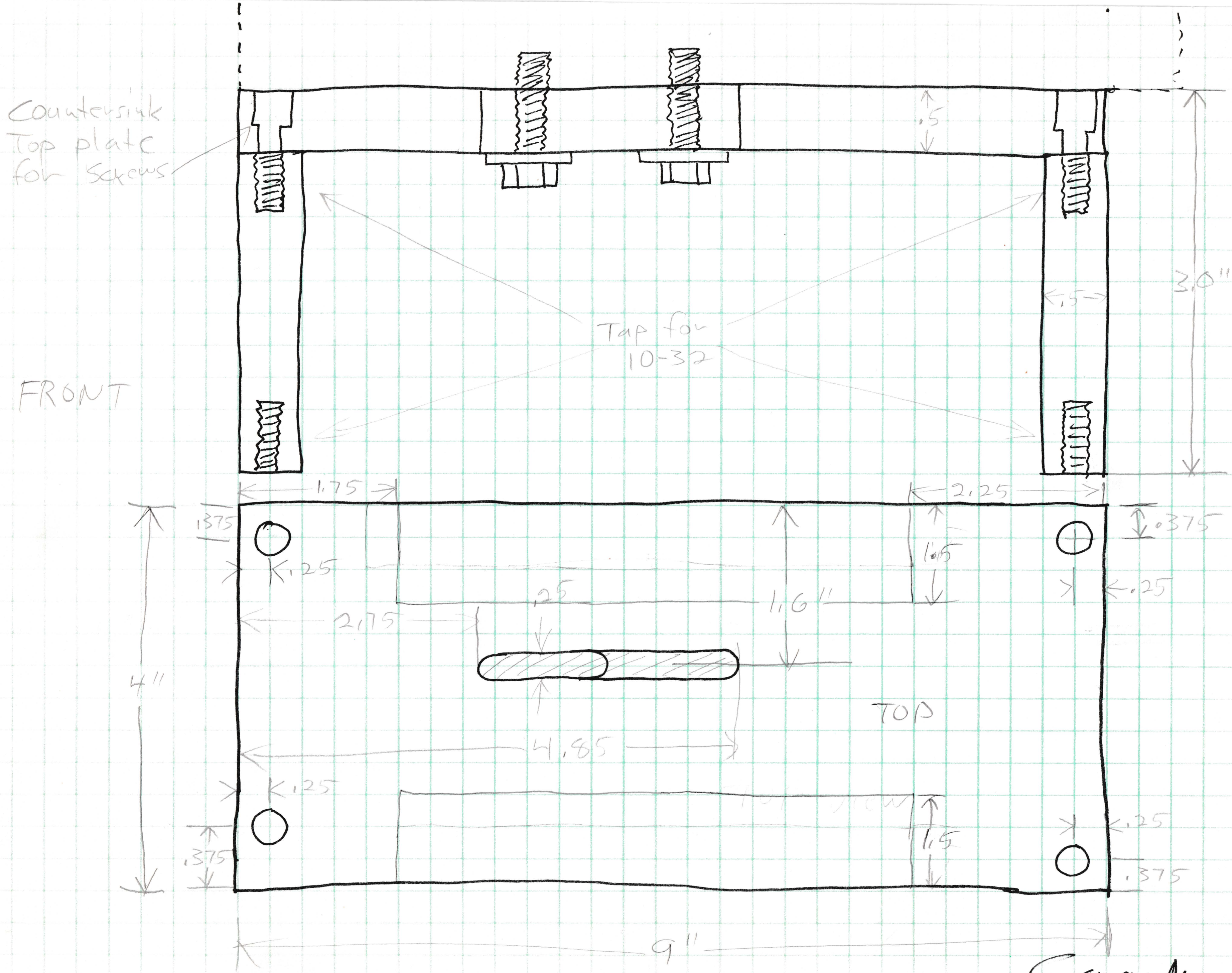
*PROBLEM: FRAME.

SOLUTION: ADD WIRES AS SHOWN:

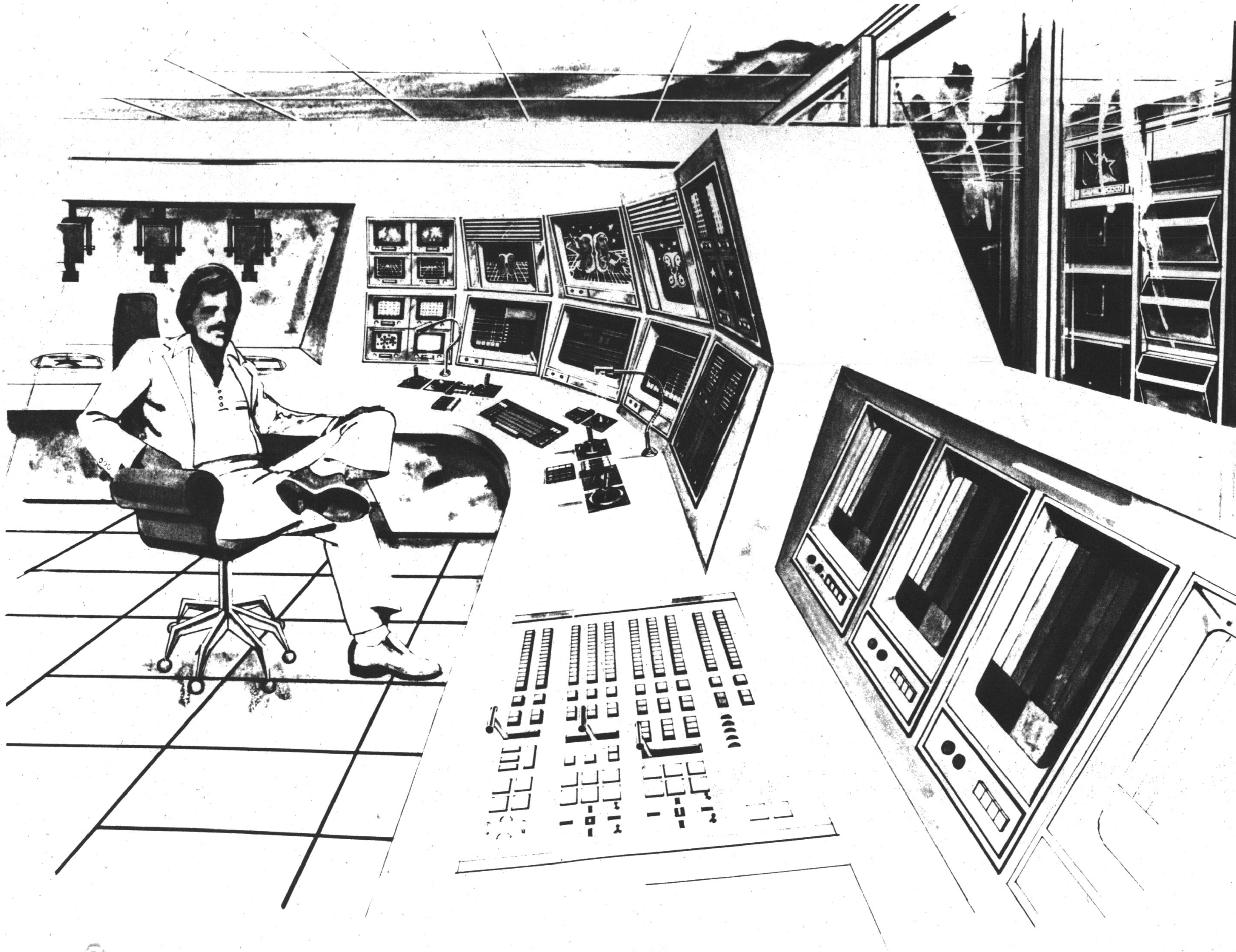
```
     J4                  J3                  J2                  J1
-----------        -----------         -----------         -----------
|     |   |        |     |   |         |     |   |         |     |   |
| 101 | 1 |        | 101 | 1 |         | 101 | 1 |         | 101 | 1 |
|     |   |        |     |   |         |     |   |         |     |   |
| 102 | 2 |        | 102 | 2 |         | 102 | 2 |         | 102 | 2 |
|     |   |        |     |   |         |     |   |         |     |   |
| 103 | 3 |        | 103 | 3 |  /------| 103 | 3 |         | 103 | 3 |
|     |   |        |     |   | /       |     |   |         |     |   |
| 104 | 4 |    /---| 104 | 4 | |       | 104 | 4 |         | 104 | 4 |
|     |   |   /    |     |   | |       |     |   |         |     |   |
| 105 | 5 |   |    | 105 | 5 | V    /--| 105 | 5 |         | 105 | 5 |
|     |   |   |    |     |   |     /   |     |   |         |     |   |
| 106 | 6 |   |    | 106 | 6 | CH  |   | 106 | 6 |         | 106 | 6 |
|     |   |   |    |     |   |     |   |     |   |         |     |   |
| 107 | 7 |   |    | 107 | 7 |     |   | 107 | 7 |         | 107 | 7 |
|     |   |   V    |     |   |     V   |     |   |         |     |   |

              CB                    CV


                             ---------------------
                             |     O 1           |
                             |       V10         |
                             |         2 O       |
                             |                   |         BACK
                             |     O CV          |
                             |       SYNC        |         VIEW
                             |        CH O       |
                             |                   |
                             |     O CB          |
                             |      BLANK        |
                             |           O       |
                             |                   |
```

*PROBLEM: BACK PANEL.

SOLUTION: DISCONNECT LOOP THRU AND COAXES TO BOTTOM 4 CONNECTORS; RE-LABEL.

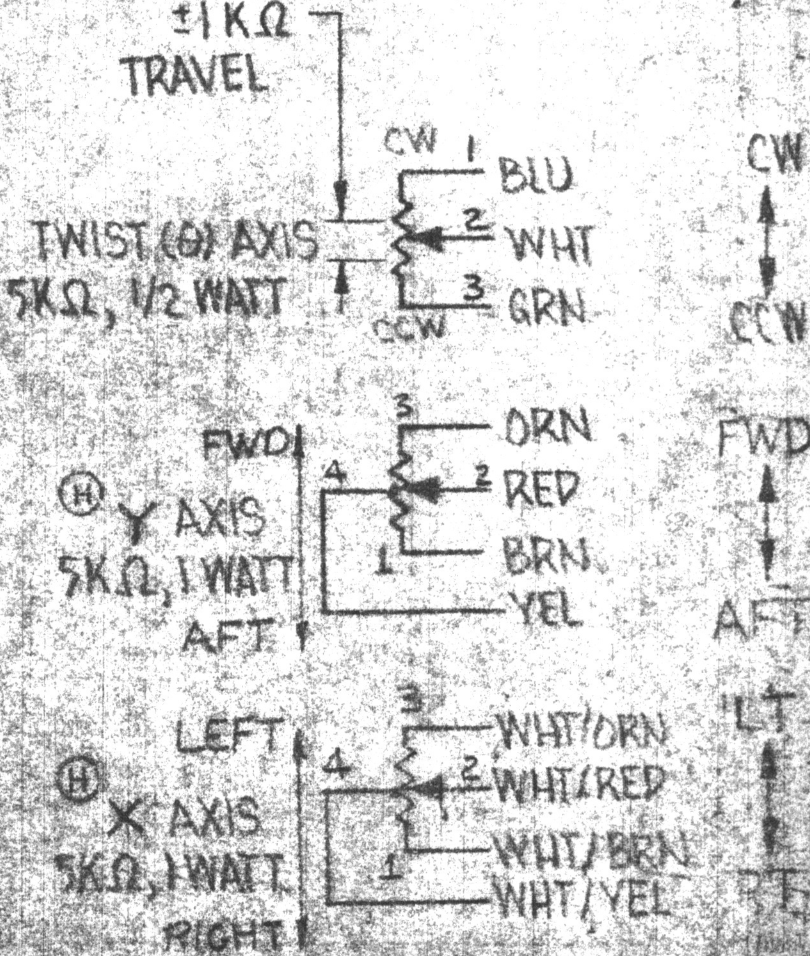


Camera Mount
Dus 11/15/82

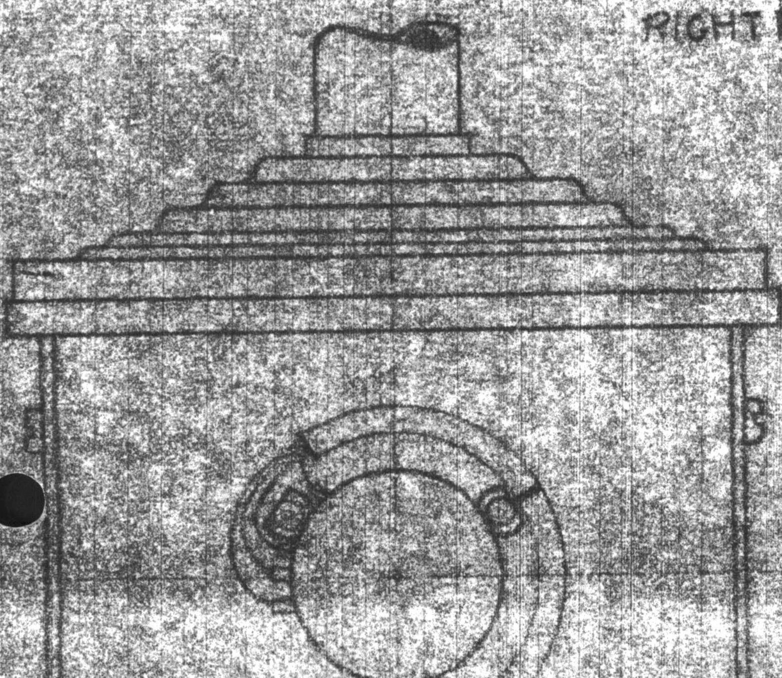


	G	REDRAWN		
C1	H	REVERSED X, Y AXIS, ADDED DIRECTIONS	2/5/79	[illegible]
	J	ADDED NOTE 8, NOTE 7 WAS 0.75 TO 1.25 IN-LBS.	2/26/79	[illegible]
	K	UPDATED PICTURE FOR LEVERS & WIRING	2/11/80	WSK
	L	NOTE 8 WAS .75 TO 1.25 IN-LBS.	6/3/80	CRC
	M	CLASS NO. ADDED TO PN	9-27-80	[illegible]

D



C



B

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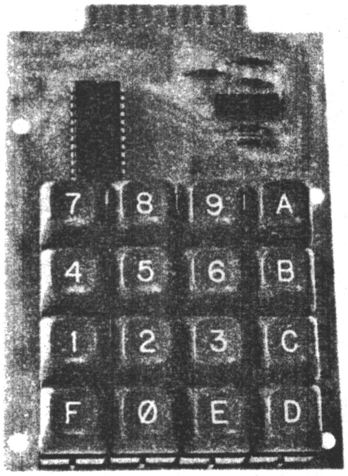
MODEL R504	KEYBOARD
16 KEY HEX ENCODED	

16 KEY HEX ENCODED



STANDARD FEATURES

- 5 year reedswitch warranty
- Single +5 VDC input with TTL output
- Gold flash for PCB connector
- Two-key rollover
- Two-shot molded gray keytops
- Low cost PCB mounting
- Sloped profile
- Off-the-shelf availability
- Hexadecimal keytop layout

OPTIONAL FEATURES

- Stepped profile with 5 different spring pressures
- Other keytop colors
- Different keytop legend sets
- Delete 4 right-hand switches for 12 key model

DESCRIPTION:

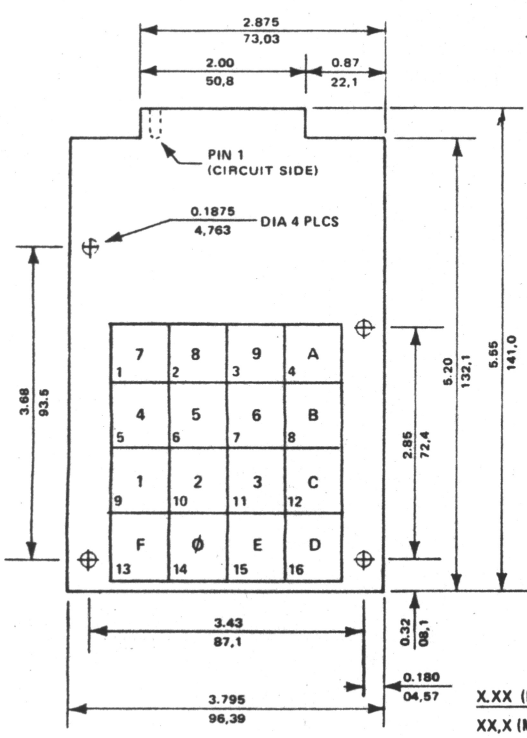
The 16 key Model R504 provides standard four bit hexadecimal encoding. This off-the-shelf design includes all of the above-mentioned standard features and the capability of inexpensively incorporating the optional features.

This quality keyboard features 16 hermetically sealed reedswitch keyswitches, double shot molded keytop legends, TTL encoding with two-key rollover. The keyswitches offer the standard travel and force of the popular electric typewriter. Sealed reed switches assure minimum 100 million key stroke reliability even under adverse environmental conditions. Two-key rollover allows for error free data entry when two or more keys are pushed simultaneously.

Key Tronic Representatives are located worldwide to assist you with your unique keyboard requirements. They have pricing, delivery and part number information on all of our standard designs, and can also work with you to specify a low cost custom keyboard to fit your special requirements.

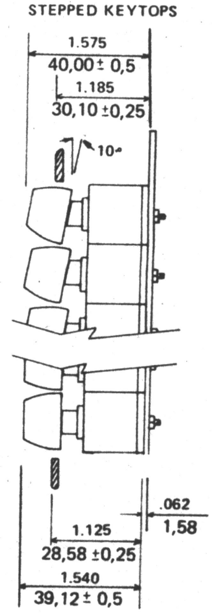
APPLICATIONS:

Credit card verification, security systems, machine tool control, limited data entry, add-on numeric pad, general program control, micro processor inter face, etc.



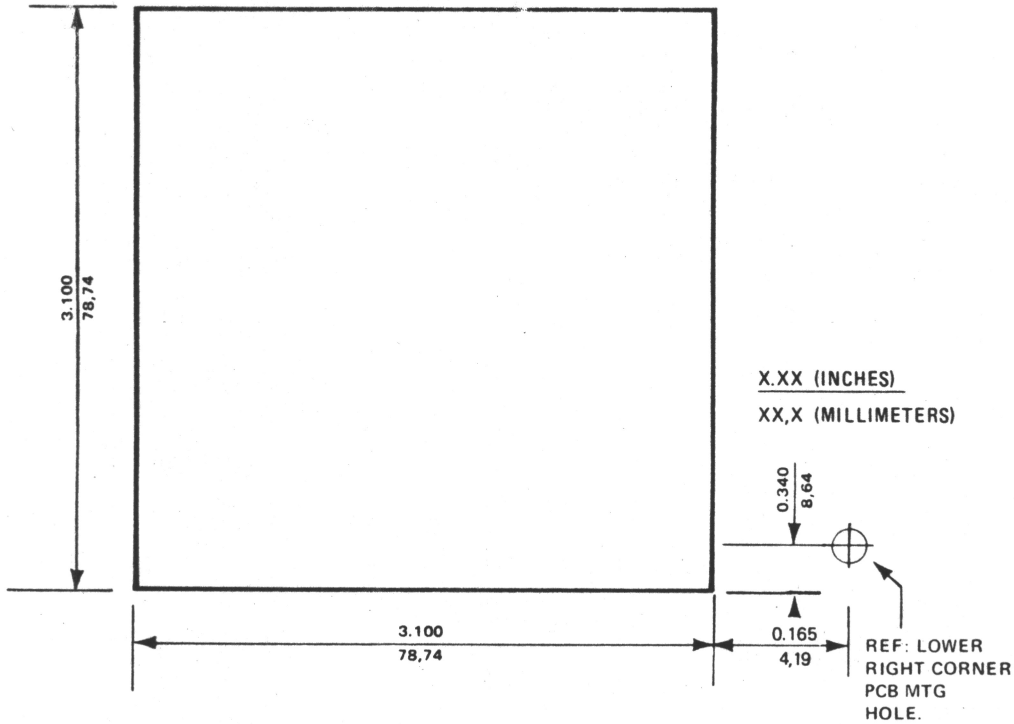
X.XX (INCHES)
XX,X (MILLIMETERS)

PROFILE FOR STEPPED KEYTOPS



PROFILE FOR SLOPED KEYTOPS

ENCLOSURE CUTOUT



CODE CHART

KEY #	CODE B4	B3	B2	B1
1	0	1	1	1
2	1	0	0	0
3	1	0	0	1
4	1	0	1	0
5	0	1	0	0
6	0	1	0	1
7	0	1	1	0
8	1	0	1	1
9	0	0	0	1
10	0	0	1	0
11	0	0	1	1
12	1	1	0	0
13	1	1	1	1
14	0	0	0	0
15	1	1	1	0
16	1	1	0	1

ELECTRICAL DATA:

Input power........................5 VDC at 100 ma
Rollover....................................2 key
Date output ....4 bit Hexadecimal (+ logic)
Strobe ....Level (+ logic)

MECHANICAL DATA

Total key travel ....0.171 in. (0.434 cm) nominal
Key force.................2.5 oz. (70.88 gr.) nominal
Key color..................Dark Gray (Cycolac 3500)
Keyswitch reliability ....100 million MCBF

CONNECTOR DETAIL

PIN	FUNCTION
1	+5 VDC
2	BIT 3
3	BIT 4
8	Strobe
9	+5 VDC
10	Ground
11	BIT 1
12	BIT 2

Recommended connector — Cinch P. N. 250-12-30-170 or equivalent.

ORDERING INFORMATION

When ordering, refer to Key Tronic part number 65-00504-004. For pricing and availability, consult our nearest representative located in principal cities, worldwide.

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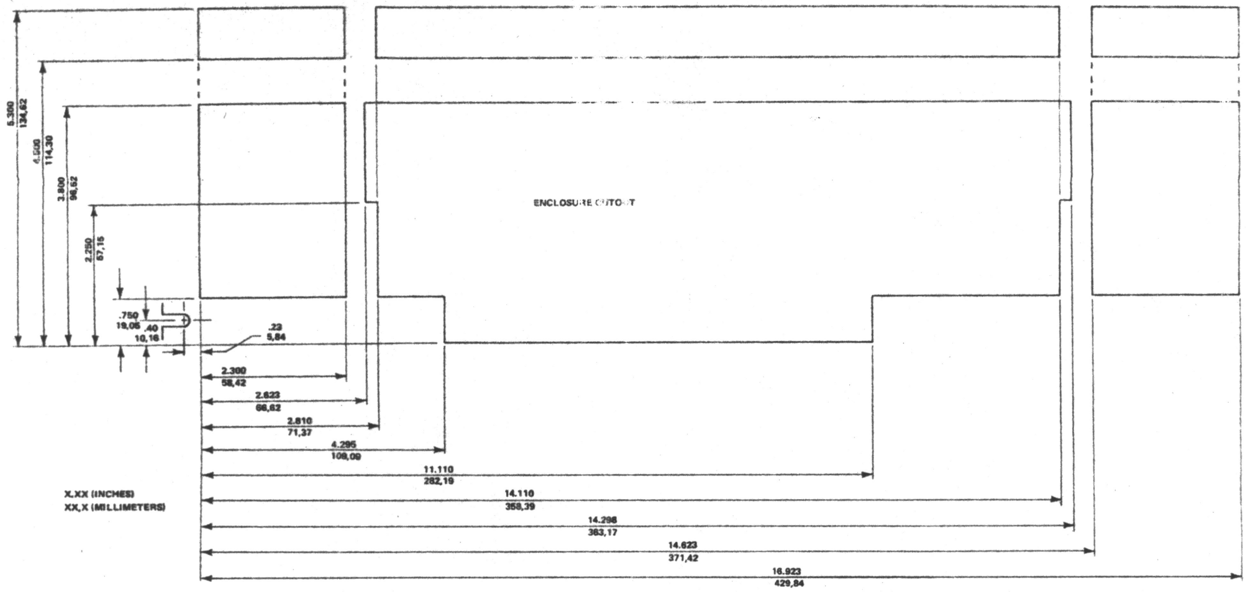
P.O. BOX 14687 SPOKANE, WA 99214 USA
TELEPHONE 509-928-8000 TWX 510 773-1885

2.5K/11-81

105 KEY "CUSTOM"



ELECTRICAL DATA

Input Power .... + 5 VDC
Rollover .... N-Key
Data Output .... 8 Bit Binary
(Bit 9 available as an option)
Strobe ...... Positive and negative pulse available

MECHANICAL DATA

Total Key Travel .... 4.34mm (0.171 in.)
Key Actuating force .... 57 gr. (2.0 oz.)
Keytop Color .... Gray Cycolac® 3500
Black Cycolac® 4500
Reliability .... 100,000,000 MCBF

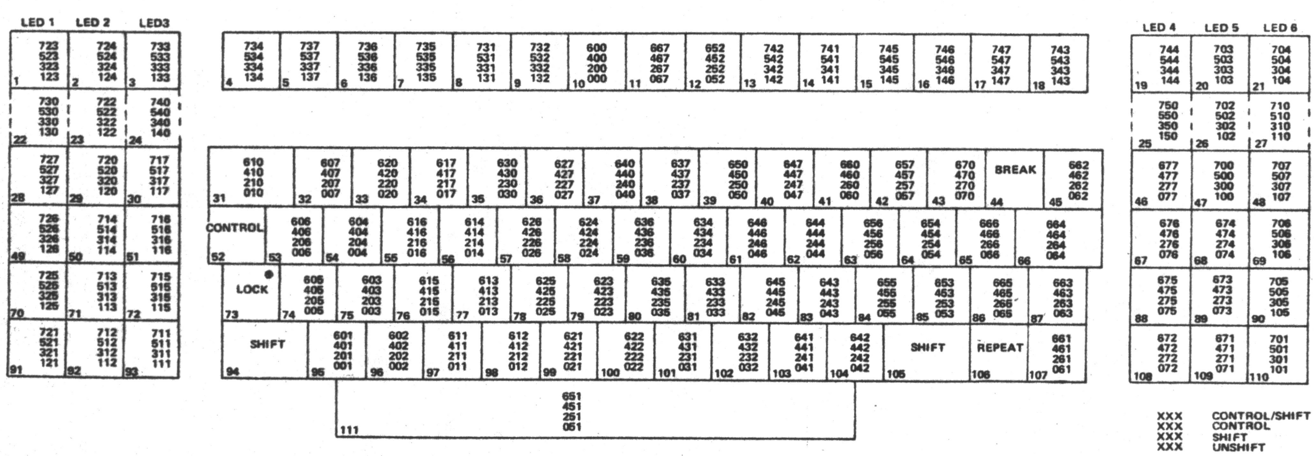
ORDERING INFORMATION

When ordering, refer to Key Tronic Part Number 65-01752-001. For price and availability, consult your nearest representative.

CONNECTOR DETAIL

1	+ 5VDC	A	+ 5VDC
2	GND	B	GND
3	BIT 1	C	BIT 2
4	BIT 3	D	BIT 4
5	BIT 5	E	BIT 6
6	BIT 7	F	BIT 8
7	STROBE	H	STROBE
8	LED KEY 1	J	LED KEY 19
9	LED KEY 2	K	LED KEY 20
10	LED KEY 3	L	LED KEY 21
11	BREAK	M	EXTRA
12	EXTRA	N	EXTRA

Recommended Mating Connector: Cinch 251-12-30-160 or Equivalent. TRW # 50-24A-30



Codes are shown in negative logic.

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TELEPHONE 509-928-8000 TWX 510 773-1885

3K/3-79

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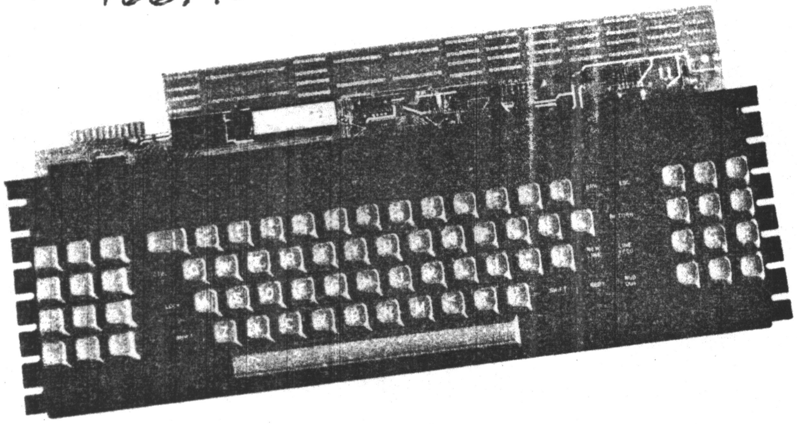
MODEL L1752	KEYBOARD
105 KEY "CUSTOM"	

1-9 200.30
10-49 166.90

105 KEY "CUSTOM"



STANDARD FEATURES

- Solid state key switches
- Single +5 VDC input
- Two-shot keytops
- N-Key rollover
- Sloped Profile
- Four modes

OPTIONAL FEATURES

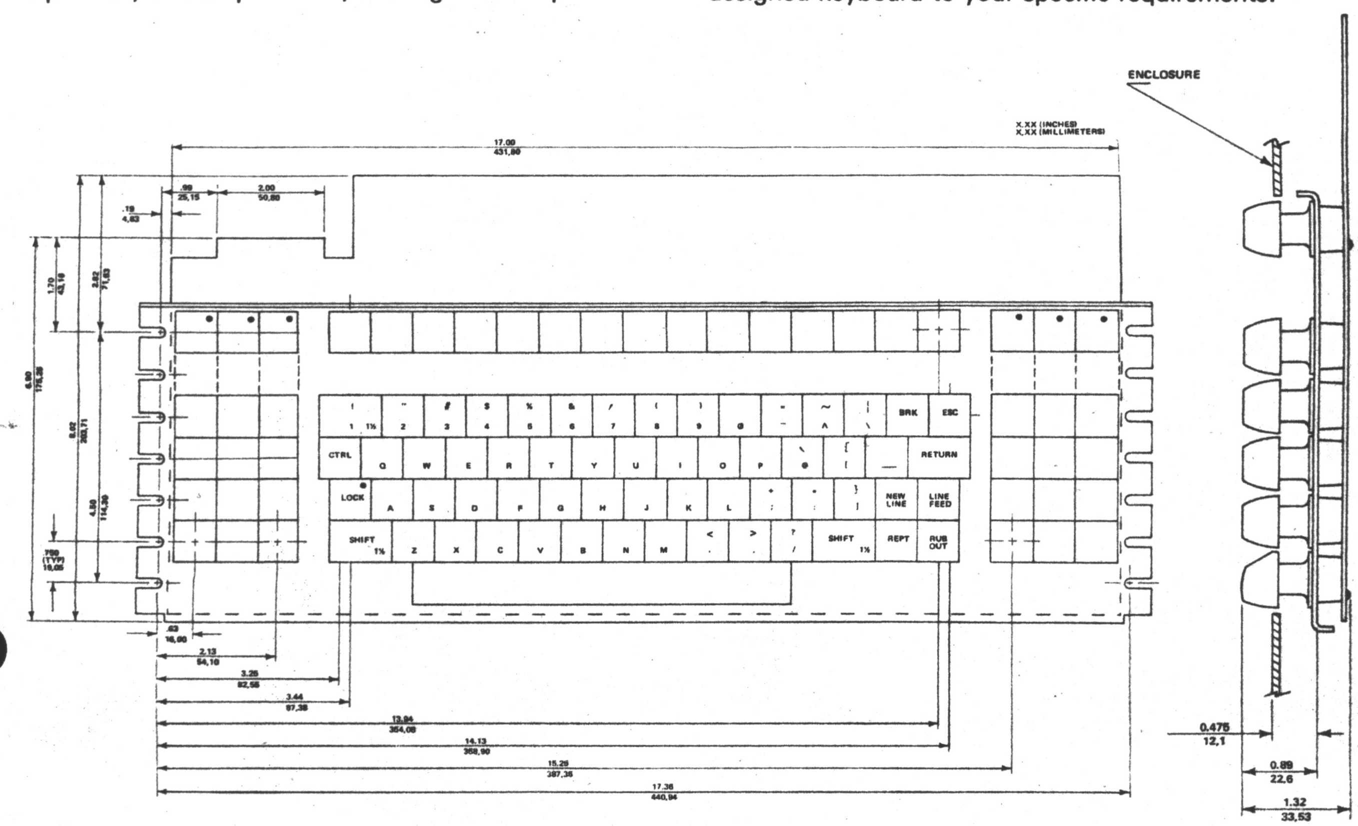
- Programmable codes
- 6 additional function keys
- Other options limited only by your imagination

DESCRIPTION:

The L1752 was designed to be easily modified by the customer. It provides an ANSI "bit pairing" layout, and 45 additional function keys (6 of which are target lighted). Customers may remove, or add, keys to arrive at the desired layout. Customers may also install a PROM to modify the output codes.

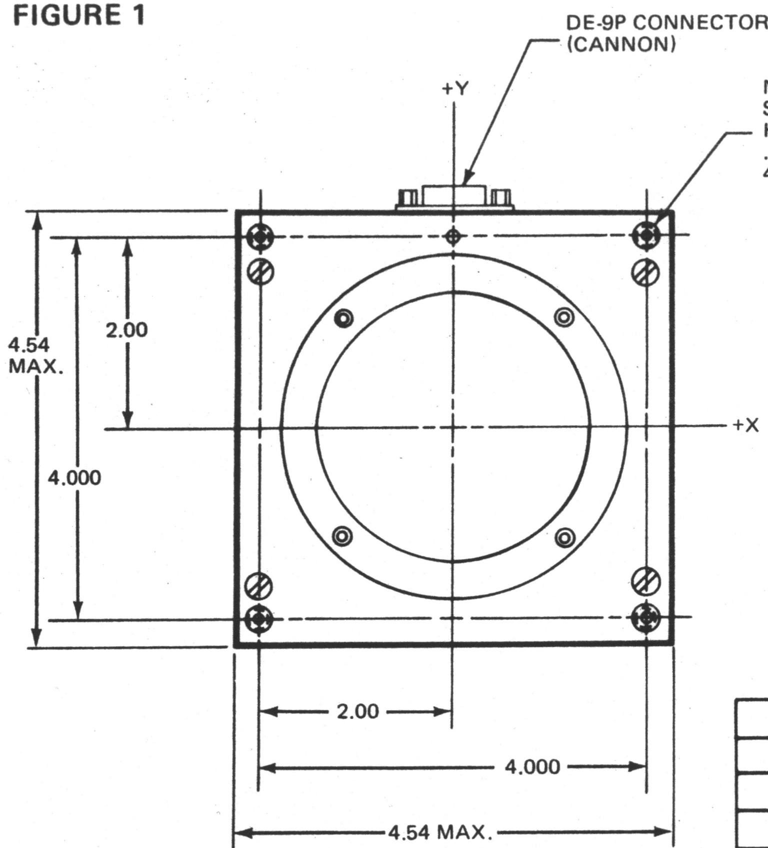
There are spare positions on the keyboard for one 40 pin I.C., two 24 pin I.C.'s, and eighteen 16 pin (or 14 pin) I.C.'s. This allows the customer to install numerous options (including a complete microcomputer). The L1752 is ideal for prototype development and for customers who require small numbers of specialized keyboards.

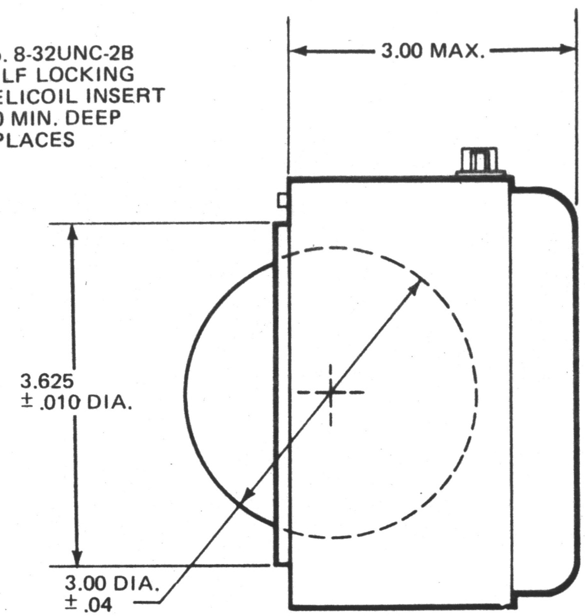
Key Tronic Sales Representatives are located worldwide to assist with your keyboard requirements. They have price, delivery, and part number information on all our standard designs and can also work with you to specify a low cost custom designed keyboard to your specific requirements.



PHYSICAL CHARACTERISTICS

FIGURE 1

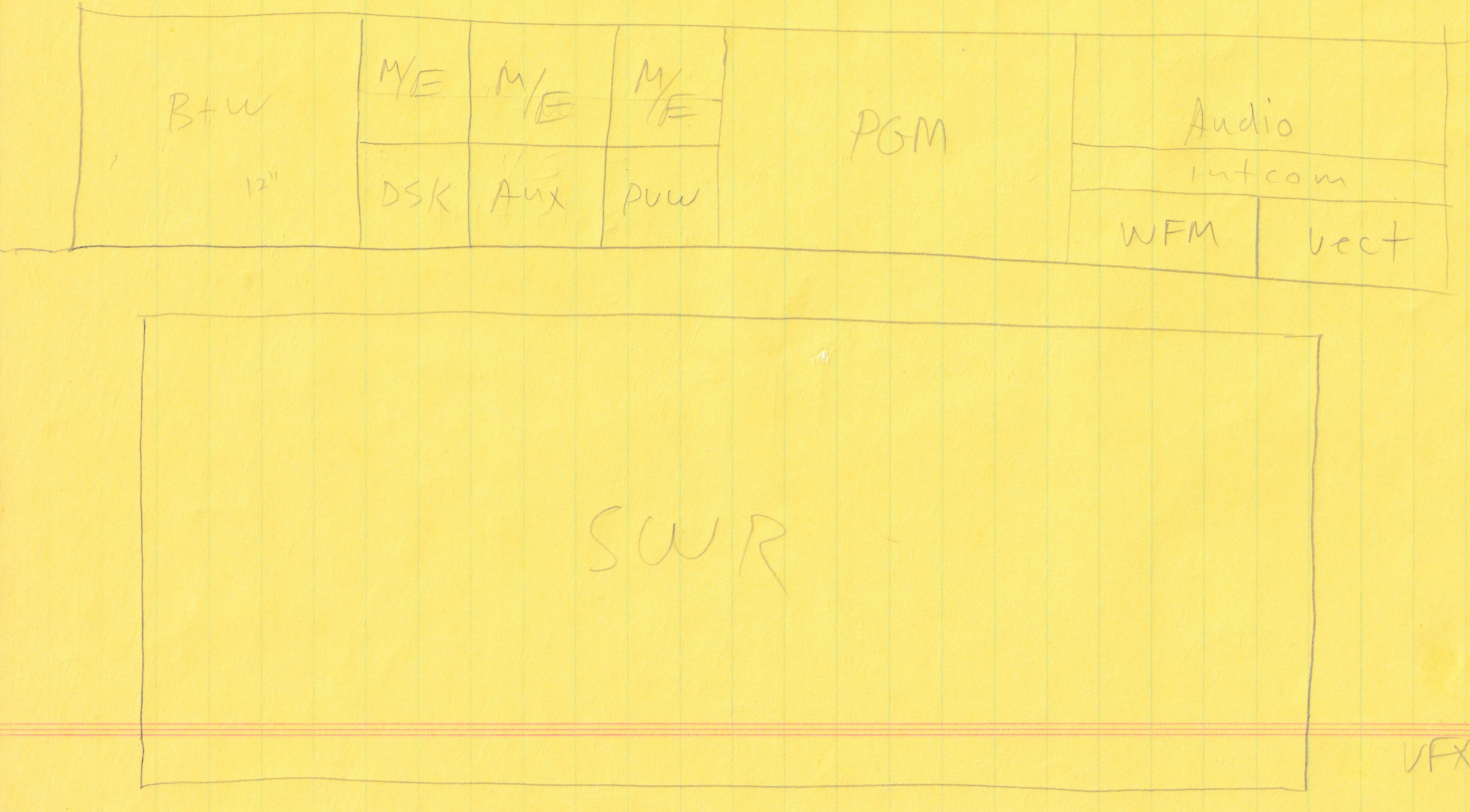




INPUT/OUTPUT CONNECTOR PIN ASSIGNMENTS

FUNCTION	PIN NUMBER	FUNCTION	PIN NUMBER
Ay	1 1	1x2x or 4x (Y+)	1
By	2 3	1x2x or 4x (Y−)	2
Ax	3 5	1x2x or 4x (X+)	3
Bx	4 7	1x2x or 4x (X−)	4
SPARE	5, 6	SPARE	5, 6
GND RETURN	7	GND RETURN	7
+5V DC	8 9	+5V DC	8
CASE GND	9	CASE GND	9

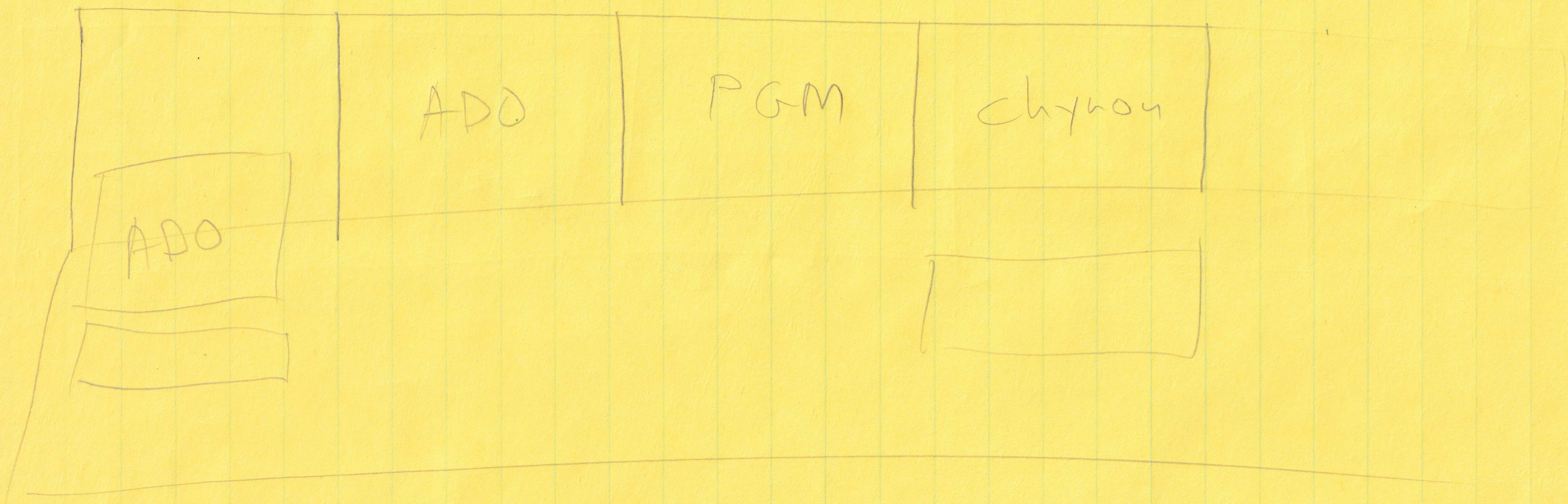
For units incorporating Line Drivers, consult factory for connector type and pin assignments.



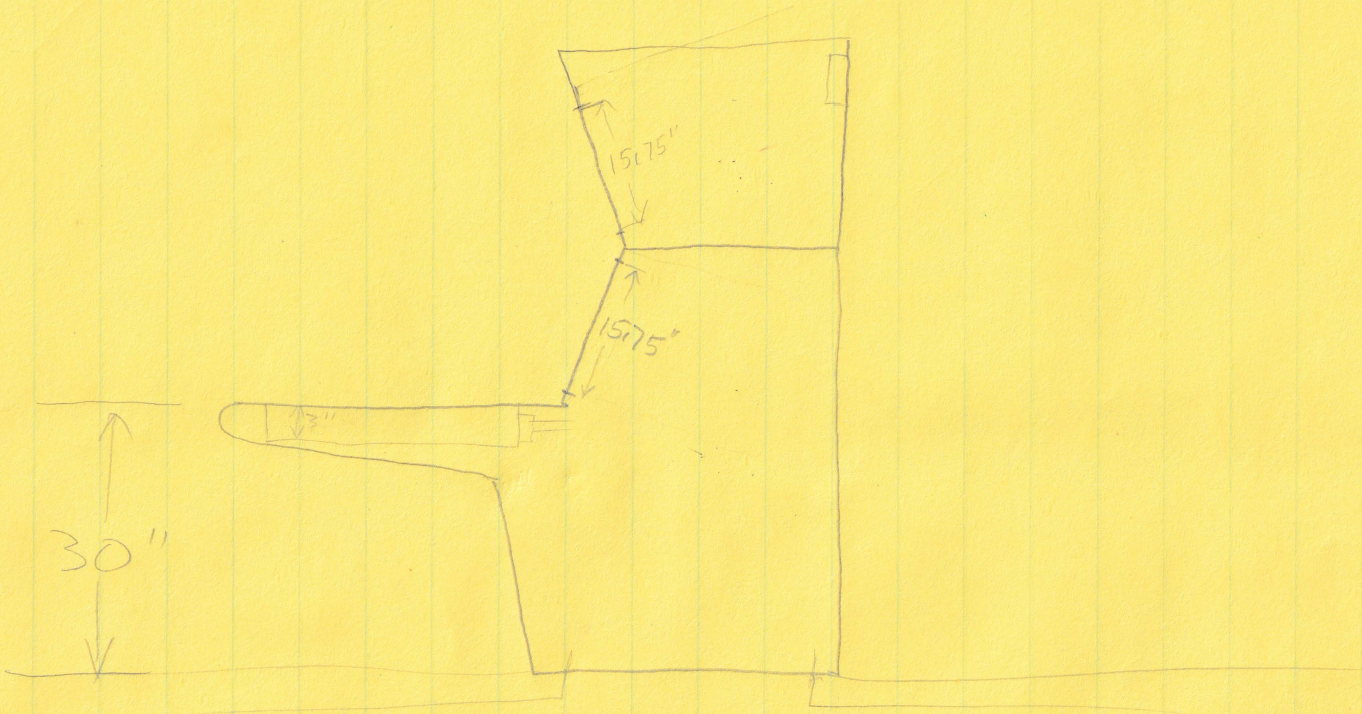
VFX1

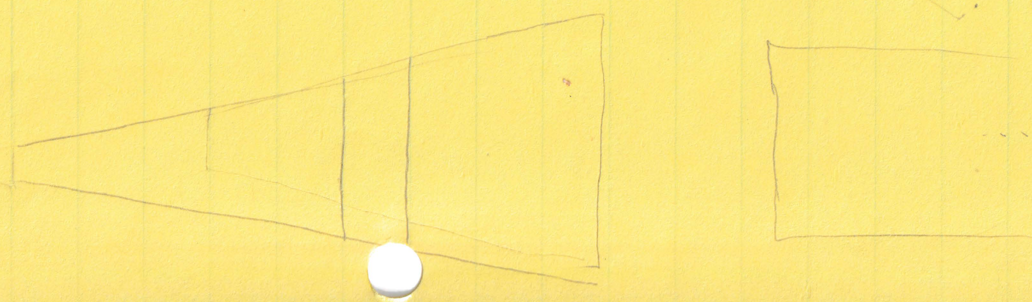

ch1
ch2
ch3
ch4
SPKR
RS
12"C
UFX
RGB
SPKR
RS
12"C
UT1
UT2
UT3
7½
UT4
UFX
Data
SWR
DATA
12" B+W
UFX
Main
Data
CMX
Data
12" B+W
UFX
Data

UFX-2



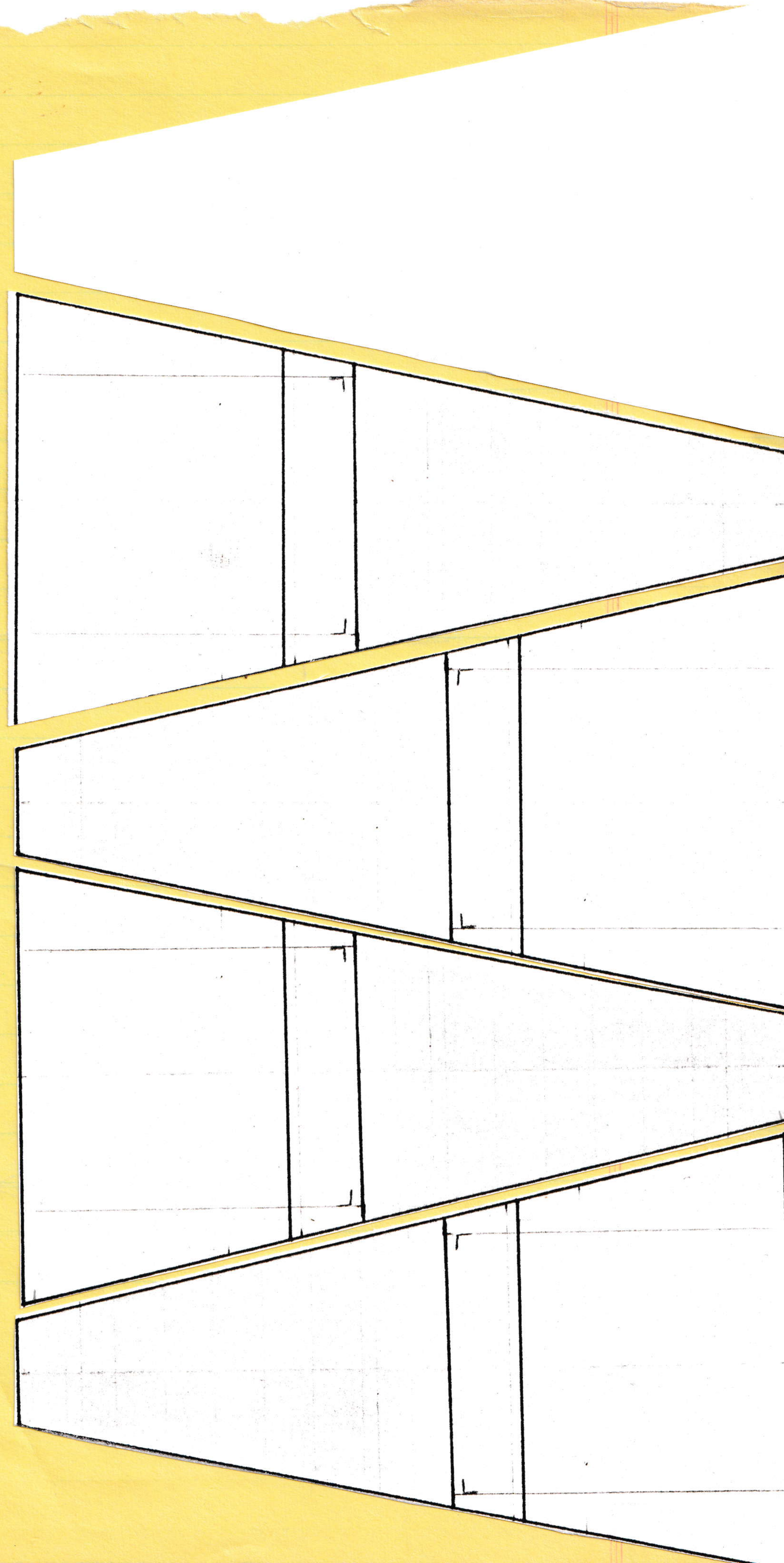
VFX-3

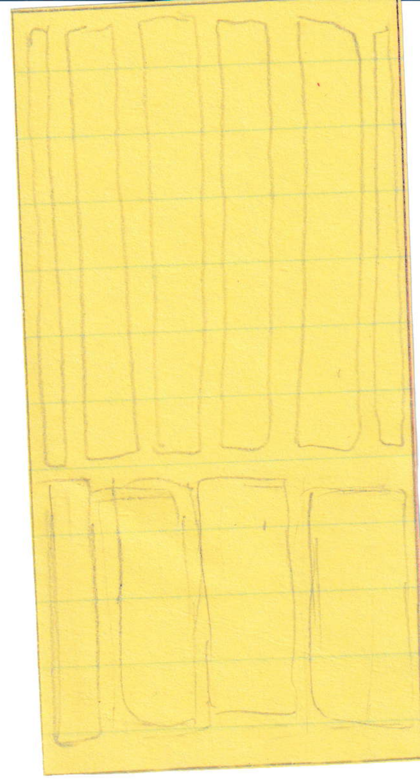

15.75"
15.75"
3"
30"

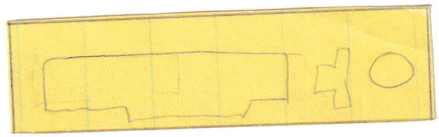


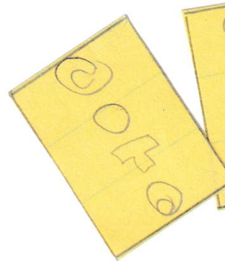
SOCIÉTÉ FRANCAISE de PRODUCTION
SFP
et de CRÉATION AUDIOVISUELLES

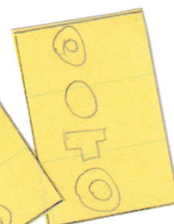
SFP West Coast Operations
1801 Avenue of the Stars
Suite 921
Los Angeles, CA.90067











8-27-82

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
1N5231B	DIODE	5.1V ZENER DIODE	HAMILTON	MOTOROLA	1N5231B
1N5240B	DIODE	10V ZENER DIODE	HAMILTON	MOTOROLA	1N5240B
1N914	DIODE	SWITCHING DIODE	HAMILTON	ANY	1N914
25LS2519	IC	QUAD REGISTER W/TWO 3-STATE OUTPUTS	HAMILTON	AMD	25LS2519
25LS2521	IC	8 BIT COMPARATOR	HAMILTON	AMD	25LS2521
25LS2537	IC	4-10 LINE DECODER	HAMILTON	AMD	25LS2537
25S08	IC	QUAD REGISTER W/ENABLE	HAMILTON	AMD	25S08
2716-25	IC	2KX8 EPROM - 250 ns	HAMILTON	MOTOROLA	2716-25
2N3509	TRANSISTOR	SWITCHING TRANSISTOR	HAMILTON	ANY	2N3509
2N3904	TRANSISTOR	MATCHING TRANSISTOR TO CA3046 ARRAY	HAMILTON	ANY	2N3904
30 MHZ OSC	OSCILLATOR	30 MHZ OSCILLATOR	SHELLEY HAMILTON	DALE DALE	XO-13B30 XO-13B30
429B	IC	FAST ANALOG MULTIPLIER	ANALOG DEV	ANALOG DEV	429B
5 MHZ OSC	OSCILLATOR	5 MHZ OCSILLATOR	HAMILTON SHELLEY	DALE DALE	XO-33D5 XO-33B5
7400	IC	QUAD 2-INPUT NAND GATE	HAMILTON	ANY	7400
74123	IC	DUAL ONE-SHOT	HAMILTON	ANY	74123
74128	IC	QUAD 50-OHM LINE DRIVER	HAMILTON	ANY	74128
74148	IC	8 BIT PRIORITY ENCODER	HAMILTON	ANY	74148
74150	IC	16-TO-1 MULTIPLEXER	HAMILTON	ANY	74150
74151	IC	8-TO-1 MULTIPLEXER	HAMILTON	ANY	74151
7416	IC	HEX INVERTERS W/OC OUTPUTS	HAMILTON	ANY	7416
74161	IC	4-BIT COUNTER	HAMILTON	ANY	74161
7427	IC	TRIPLE 3-INPUT NOR GATES	HAMILTON	ANY	7427
7428	IC	QUAD 2-INPUT NOR BUFFERS	HAMILTON	ANY	7428
7433	IC	QUAD 2-INPUT NOR BUFFERS W/OC OUTPUTS	HAMILTON	ANY	7433
74F521	IC	8 BIT COMPARATOR	HAMILTON	FAIRCHILD	74F521
74LS00	IC	QUAD 2-INPUT NAND GATE	HAMILTON	ANY	74LS00

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
74LS02	IC	QUAD 2-INPUT NOR GATE	HAMILTON	ANY	74LS02
74LS04	IC	HEX INVERTER	HAMILTON	ANY	74LS04
74LS08	IC	QUAD 2-INPUT AND GATE	HAMILTON	ANY	74LS08
74LS10	IC	TRIPLE 3-INPUT NAND GATE	HAMILTON	ANY	74LS10
74LS11	IC	TRIPLE 3-INPUT AND GATE	HAMILTON	ANY	74LS11
74LS112	IC	DUAL J-K FLIP-FLOP	HAMILTON	ANY	74LS112
74LS138	IC	3-TO-8 LINE DECODER	HAMILTON	ANY	74LS138
74LS139	IC	DUAL 2-4 LINE DECODER	HAMILTON	ANY	74LS139
74LS153	IC	DUAL 4 TO 1 LINE MULTIPLEXERS	HAMILTON	ANY	74LS153
74LS157	IC	QUAD 2-1 DATA MULTIPLEXER	HAMILTON	ANY	74LS157
74LS158	IC	QUAD 2-1 INV DATA MULTIPLEXERS	HAMILTON	ANY	74LS158
74LS161	IC	4-BIT COUNTER	HAMILTON	ANY	74LS161
74LS164	IC	8 BIT SERIAL IN/ PARALLEL OUT REGISTER	HAMILTON	ANY	74LS164
74LS175	IC	QUAD REGISTER W/CLEAR	HAMILTON	ANY	74LS175
74LS20	IC	DUAL 4-INPUT NAND GATE	HAMILTON	ANY	74LS20
74LS240	IC	OCTAL BUS DRIVER	HAMILTON	ANY	74LS240
74LS244	IC	OCTAL BUS DRIVER	HAMILTON	ANY	74LS244
74LS245	IC	OCTAL BUS TRANCIEVER	HAMILTON	ANY	N8T245N
			HAMILTON	ANY	74LS245
			HAMILTON	ANY	74LS645
74LS260	IC	DUAL 5-INPUT NOR GATE	HAMILTON	ANY	74LS260
74LS30	IC	8-INPUT NAND GATE	HAMILTON	ANY	74LS30
74LS32	IC	QUAD 2-INPUT OR GATE	HAMILTON	ANY	74LS32
74LS373	IC	OCTAL TRI-STATE LATCH	HAMILTON	ANY	74LS373
74LS374	IC	OCTAL TRI-STATE REGISTER	HAMILTON	ANY	74LS374
74LS377	IC	OCTAL REGISTER WITH ENABLE	HAMILTON	ANY	74LS377
74LS74A	IC	DUAL D FLIP-FLOP	HAMILTON	ANY	74LS74A
74LS85	IC	4 BIT COMPARATOR	HAMILTON	ANY	74LS85

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
74LS86	IC	QUAD 2-INPUT EXOR GATE	HAMILTON	ANY	74LS86
74S00	IC	QUAD 2-INPUT NAND GATE	HAMILTON	ANY	74S00
74S02	IC	QUAD 2-INPUT NOR GATE	HAMILTON	ANY	74S02
74S04	IC	HEX INVERTER	HAMILTON	ANY	74S04
74S10	IC	TRIPLE 3-INPUT NAND GATE	HAMILTON	ANY	74S30
74S112	IC	DUAL J-K FILP-FLOP	HAMILTON	ANY	74S112
74S138	IC	3-TO-8 LINE DECODER	HAMILTON	ANY	74S138
74S139	IC	DUAL 2-TO-4 LINE DECODER	HAMILTON	ANY	74S139
74S153	IC	DUAL 4-1 DATA MULTIPLEXERS	HAMILTON	ANY	74S153
74S157	IC	QUAD 2-1 DATA MULTIPLEXER	HAMILTON	ANY	74S157
74S161	IC	4-BIT COUNTER	HAMILTON	ANY	74S161
74S188	IC	32X8 PROM	HAMILTON	ANY	74S188
74S189	IC	16X4 TTL RAM	HAMILTON	ANY	74S189
74S195	IC	4-BIT SHIFT REGISTER	HAMILTON	ANY	74S195
74S20	IC	DUAL 4-INPUT NAND GATE	HAMILTON	ANY	74S20
74S240	IC	OCTAL BUS DRIVER	HAMILTON	ANY	74S240
74S244	IC	OCTAL BUS DRIVER	HAMILTON	ANY	74S244
74S260	IC	DUAL 5-INPUT NOR GATE	HAMILTON	ANY	74S260
74S299	IC	8 BIT SHIFT REGISTER	KIERULFF	T. I.	74S299
74S30	IC	TRIPLE 3-INPUT NAND GATE	HAMILTON	ANY	74S30
74S32	IC	QUAD OR GATE	HAMILTON	ANY	74S32
74S37	IC	QUAD 2-INPUT NAND BUFFERS	HAMILTON	ANY	74S37
74S38	IC	QUAD 2-INPUT NAND BUFFER W/OC OUTPUT	HAMILTON	ANY	74S38
74S74	IC	DUAL D FLIP-FLOP	HAMILTON	ANY	74S74
75160A	IC	IEEE-488 BUS DRIVER	RPS ELECTR	T. I.	75160A
75162A	IC	IEEE-488 BUS DRIVER	RPS ELECTR	T. I.	75162A
AD533JH	IC	ANALOG MULTIPLIER	ANALOG DEV	ANALOG DEV	AD533JH

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
AD558	IC	8 BIT DAC	ANALOG DEV	ANALOG DEV	AD558KD
AH0134	IC	DUAL ANALOG SWITCH	HAMILTON	NATIONAL	AH0134CD
AM2940	IC	DMA ADDRESS GENERATOR	HAMILTON	AMD	AM2940
AM9519A-1	IC	INTERRUPT CONTROLLER	HAMILTON	AMD	AM9519A-1
~~C .01UF 50V CER~~	~~CAPACITOR~~	~~.01 UF CERAMIC CAPACITOR~~	~~HAMILTON~~	~~KEMET~~	~~C323C103M2R5CA~~
C .01UF 50V CER T.S.	CAPACITOR	.01 UF TEMP STABLE CERAMIC CAPACITOR	HAMILTON	KEMET	C323C103M2G5CA
C .1UF 50V CER	CAPACITOR	.1 UF CERAMIC CAPACITOR	HAMILTON	KEMET	C323C104M5R5CA
C .1UF 50V CER .25S	CAPACITOR	.1 UF 50V CERAMIC CAPACITOR	HAMILTON	KEMET	C321C104M5R5CA
C .1UF CER T.S.	CAPACITOR	.1 TEMP. STABLE CERAMIC CAPACITOR	HAMILTON	KEMET	C350C104K1G5CA
			HAMILTON	KEMET	C350C104K2G5CA
C .22UF 50V CER T.S.	CAPACITOR	.22 UF TEMP STABLE CERAMIC CAPACITOR	HAMILTON	KEMET	C323C224M2G5CA
C 1000PF CER T.S.	CAPACITOR	1000 PF TEMP. STABLE CERAMIC CAPACITOR	HAMILTON	KEMET	C323C102M2G5CA
			HAMILTON	KEMET	C323C102K2G5CA
C 100PF CER T.S.	CAPACITOR	100 PF TEMP STABLE CERAMIC CAPACITOR	HAMILTON	KEMET	C323C101K2G5CA
C 100UF 20V TAN	CAPACITOR	100 UF 20V TANTALUM CAPACITOR	HAMILTON	KEMET	T110D107K020AS
C 10UF 25V TAN	CAPACITOR	10 UF 25V CERAMIC CAPACITOR	HAMILTON	KEMET	T392C106K025AS
C 18PF CER T.S.	CAPACITOR	18 PF TEMP STABLE ~~CERAMIC~~ TAN CAPACITOR	HAMILTON	KEMET	C323C180K2G5CA
C 1UF 25V TAN	CAPACITOR	1 UF 25V CERAMIC CAPACITOR	HAMILTON	KEMET	T392A105K025AS
C 39PF CER T.S.	CAPACITOR	39 PF TEMP STABLE CERAMIC CAPACITOR	HAMILTON	KEMET	C323C390K2G5CA
C 4.7PF 50V CER	CAPACITOR	4.7 PF 50V CERAMIC CAPACITOR	HAMILTON	KEMET	C312C479D2G5CA 158
			HAMILTON	KEMET	C323C479K2G5CA
C 47UF 20V TAN	CAPACITOR	47 UF 20V TANTALUM CAPACITOR	HAMILTON	KEMET	T110C476K020AS
C 47UF 25V TAN	CAPACITOR	47 UF 25V TANTALUM CAPACITOR	HAMILTON	KEMET	T390E476M025AS
			HAMILTON	SPRAGUE	199D476X0025EA2
C 560PF CER T.S.	CAPACITOR	560 PF TEMP STABLE CERAMIC CAPACITOR	HAMILTON	KEMET	C323C561M2G5CA
C 56PF CER T.S.	CAPACITOR	56 PF TEMP STABLE CERAMIC CAPACITOR	HAMILTON	KEMET	C323C560K2G5CA
C 68UF 16V TAN	CAPACITOR	68 UF 16V TANTALUM CAPACITOR	HAMILTON	KEMET	T390E686M016AS
			HAMILTON	SPRAGUE	199D686X0016EA2
CA3046	TRAN ARRAY	NPN TRANSISTOR ARRAY	HAMILTON	ANY	CA3046

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
CD4040	IC	CMOS 12 STAGE COUNTER	HAMILTON	ANY	CD4040BCN
CD4046	IC	CMOS PHASE-LOCKED LOOP	HAMILTON	ANY	CD4046BCN
COAX JACK	CONNECTOR	AMPHENOL SMA COAX JACK	KIERULF	AMPHENOL	901-143
DAC-80	IC	12 BIT DAC WITH OP AMP	ANALOG DEV	ANALOG DEV	AD DAC-80 CB1-V
DIP SOCKET-14 ST	SOCKET	14 PIN SOLDER TAIL DIP SOCKET	HAMILTON	AUGAT	214-AG-49D
DIP SOCKET-16 ST	SOCKET	16 PIN SOLDER TAIL DIP SOCKET	HAMILTON	AUGAT	216-AG-49D
DIP SOCKET-20 ST	SOCKET	20 PIN SOLDER TAIL DIP SOCKET	HAMILTON	AUGAT	220-AG-49D
DIP SOCKET-22 ST	SOCKET	22 PIN SOLDER TAIL DIP SOCKET	HAMILTON	AUGAT	222-AG-49D
DIP SOCKET-24 ST	SOCKET	24 PIN SOLDER TAIL DIP SOCKET	HAMILTON	AUGAT	224-AG-49D
DIP SOCKET-28 ST	SOCKET	28 PIN SOLDER TAIL DIP SOCKET	HAMILTON	AUGAT	228-AG-49D
DIP SOCKET-40 ST	SOCKET	40 PIN SOLDER TAIL DIP SOCKET	HAMILTON	AUGAT	240-AG-49D
DIP SOCKET-48 ST	SOCKET	48 PIN SOLDER TAIL DIP SOCKET (2-24 PIN)	HAMILTON	AUGAT	224-AG-49D (QTY X2)
DM8130	IC	10 BIT COMPARATOR	HAMILTON	NATIONAL	DM8130N
DM8520	IC	DIVIDE BY N COUNTER	HAMILTON	NATIONAL	DM8520N
DM8599	IC	16X4 RAM	HAMILTON	NATIONAL	DM8599
DM87S191	IC	2KX8 BIPOLAR PROM	HAMILTON	NATIONAL	DM87S191
DP8408	IC	DYNAMIC RAM REFRESH CONTROLLER	HAMILTON	NATIONAL	DP8408
EJECTOR	HARDWARE	CALMARK 107-1013 EJECTOR	~~HAMILTON~~	CALMARK	107-1013
HA2535	IC	FAST FET OP-AMP	HAMILTON	HARRIS	HA2-2535-5
HA4925	IC	QUAD COMPARATOR	HAMILTON	HARRIS	HA1-4925-5
HA5195	IC	FAST OP AMP	HAMILTON	HARRIS	HA1-5195-5
HDH-1205	IC	FAST 12 BIT DAC	ANALOG DEV	ANALOG DEV	HDH-1205
HI506	IC	16X1 ANALOG SW	HAMILTON	HARRIS	HI3-0506-5
J SCOTCHFLEX 40-RAST	JACK	40 PIN RIGHT ANGLE SOLDER TAIL HEADER	RICHEY	3M	3432-1303
J SCOTCHFLEX 60-RAWW	JACK	60 PIN RIGHT ANGLE WIRE WRAP HEADER	RICHEY	3M	3372-3305
JB-10	JUMPER BLK	10 PIN JUMPER BLK			
JB-14	JUMPER BLK	14 PIN JUMPER BLK			

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
JB-18	JUMPER BLK	18 PIN JUMPER BLK			
JB-2	JUMPER BLK	2 PIN JUMPER BLK			
JB-4	JUMPER BLK	4 PIN JUMBER BLOCK			
LED GREEN 90 DEG	LED	GREEN 90 DEGREE LED	PACIFIC	?	5300HS
LED RED 90 DEG	LED	RED 90 DEGREE LED	PACIFIC	?	5300HI
LH0062	IC	FET OP-AMP	HAMILTON	NATIONAL	LH0062CD
LH0070	IC	PRECISION BCD REFERENCE	HAMILTON	NATIONAL	LH0070
MC34002	IC	DUAL FET OP AMP	HAMILTON	MOTOROLA	MC34002P
MC68B09	IC	2 MHZ 6809 MICRO-PROCESSOR	HAMILTON	MOTOROLA	MC68B09P
MC68B21	IC	2 MHZ PIA	HAMILTON	MOTOROLA	MC68B21P
MC68B40	IC	2 MHZ DMA CONTROLLER	HAMILTON	MOTOROLA	MC68B40P
MC68B44	IC	2 MHZ TIMMER	HAMILTON	MOTOROLA	MC68B44P
MCM6665A-15	IC	150 ns 64K DYNAMIC RAM	HAMILTON	MOTOROLA	MCM6665AL-15
MPQ2907	TRAN ARRAY	PNP TRANSISTOR ARRAY	HAMILTON	MOTOROLA	MPQ2907
MPQ6002	TRAN ARRAY	COMPLIMENTARY TRANSISTOR ARRAY	HAMILTON	MOTOROLA	MPQ6002
NE527	IC	FAST COMPARATOR	HAMILTON	SIGNETICS	NE527N
P SCOTCHFLEX 40	PLUG	40 PIN CONNECTOR	RICHEY	3M	3417-7040
PAL16R4	IC	16R4 PAL LOGIC ARRAY	HAMILTON	NATIONAL	PAL16R4
R 1 OHM 1/2W 1%	RESISTOR	1 OHM 1/2W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-1
R 1.3K OHM 1/4W 1%	RESISTOR	1.3K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-1.3K
R 1.4K OHM 1/4W 1%	RESISTOR	1.4K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-1.4K
R 1.5K OHM 1/4W 2%	RESISTOR	1.5K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-1.5K
R 1.62K OHM 1/4W 1%	RESISTOR	1.62K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-1.62K
R 10 OHM 1/4W 1%	RESISTOR	10 OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-10
R 10 OHM 1/4W 2%	RESISTOR	10 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-10
R 100 OHM 1/4W 1%	RESISTOR	100 OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-100
R 100K OHM 1/4W 1%	RESISTOR	100K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-100K

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
R 10K OHM 1/4W 1%	RESISTOR	10K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-10K
R 10K OHM 1/4W 2%	RESISTOR	10K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-10K
R 12K OHM 1/4W 2%	RESISTOR	12K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-12K
R 150 OHM 1/4W 2%	RESISTOR	150 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-150
R 150K OHM 1/4W 2%	RESISTOR	150K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-150K
R 15K OHM 1/4W 1%	RESISTOR	15K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-15K
R 15K OHM 1/4W 2%	RESISTOR	15K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-15K
R 180K OHM 1/4W 2%	RESISTOR	180K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-180K
R 1K OHM 1/4W 1%	RESISTOR	1K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-1K
R 1K OHM 1/4W 2%	RESISTOR	1K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-1K
R 2.21K OHM 1/4W 1%	RESISTOR	2.21K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-2.21K
R 2.21K OHM 1/4W 2%	RESISTOR	2.21K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-2.21K
R 2.2M OHM 1/4W 2%	RESISTOR	2.2M 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-2.2M
R 2.4K OHM 1/4W 1%	RESISTOR	2.4K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-2.4K
R 2.74K OHM 1/4W 1%	RESISTOR	2.74K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-2.74K
R 200 OHM 1/4W 1%	RESISTOR	200 OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-200
R 200 OHM 1/4W 2%	RESISTOR	200 OHM 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-200
R 20K OHM 1/4W 2%	RESISTOR	20K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-20K
R 24.9K OHM 1/4W 1%	RESISTOR	24.9K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-24.9K
R 27.4K OHM 1/4W 2%	RESISTOR	27.4K OHM 1/4W 2% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-27.4K
R 2K OHM 1/4W 1%	RESISTOR	2K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-2K
R 2K OHM 1/4W 2%	RESISTOR	2K OHM 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-2K
R 3.01K OHM 1/4W 1%	RESISTOR	3.01K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-3.01K
R 3.32K OHM 1/4W 1%	RESISTOR	3.32K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-3.32K
R 3.32K OHM 1/4W 2%	RESISTOR	3.32K OHM 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-3.32K
R 332 OHM 1/4W 2%	RESISTOR	332 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-332
R 332K OHM 1/4W 1%	RESISTOR	332K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SPR5000 SERIES-332K

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
R 33K OHM 1/4W 2%	RESISTOR	33K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-33K
R 4.75K OHM 1/4W 1%	RESISTOR	4.75K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-4.75K
R 4.75K OHM 1/4W 2%	RESISTOR	4.75K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-4.75K
R 432 OHM 1/4W 1%	RESISTOR	432 OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-432
R 47.5K OHM 1/4W 1%	RESISTOR	47.5K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-47.5K
R 47.5K OHM 1/4W 2%	RESISTOR	47.5K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-47.5K
R 475 OHM 1/4W 1%	RESISTOR	475 OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-475
R 475 OHM 1/4W 2%	RESISTOR	475 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-475
R 5.62K OHM 1/4W 1%	RESISTOR	5.62K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-5.62K
R 51.1 OHM 1/4W 1%	RESISTOR	51.1 OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-51.1
R 6.19K OHM 1/4W 1%	RESISTOR	6.19K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-6.19K
R 6.81K OHM 1/4W 1%	RESISTOR	6.81K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-6.81K
R 681 OHM 1/4W 1%	RESISTOR	681 OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-681
R 681K OHM 1/4W 1%	RESISTOR	681K OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-681K
R 68K OHM 1/4W 2%	RESISTOR	68K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-68K
R 75 OHM 1/4W 2%	RESISTOR	75 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-75
R 75K OHM 1/4W 2%	RESISTOR	75K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-75K
R 8.25K OHM 1/4W 2%	RESISTOR	8.25K 1/4W 2% RESISTOR	HAMILTON	MEPCO	CR5000 SERIES-8.25K
R 825 OHM 1/4W 1%	RESISTOR	825 OHM 1/4W 1% RESISTOR	HAMILTON	MEPCO	SFR5000 SERIES-825
RND SOCKET-10 ST	SOCKET	10 PIN SOLDER TAIL ROUND SOCKET	HAMILTON	AUGAT	8059-2G9
RND SOCKET-3 ST	SOCKET	3 PIN SOLDER TAIL ROUND SOCKET	HAMILTON	AUGAT	8059-2G1
RND SOCKET-8 ST	SOCKET	8 PIN SOLDER TAIL ROUND SOCKET	HAMILTON	AUGAT	8059-2G7
RP 1K OHM SIP-6	RES NET	1K OHM 6 PIN SIP RESISTOR NETWORK	HAMILTON	BOURNS	4306R-101-102
RP 2.2K OHM SIP-10	RES NET	2.2K OHM 10 PIN SIP RESISTOR NETWORK	HAMILTON HAMILTON	BOURNS MEPCO	4310R-101-222 9S10E13A2201GL002
RP 2.2K OHM SIP-8	RES NET	2.2K OHM 8 PIN SIP RESISTOR NETWORK	HAMILTON	?	9S09E13A2201GL002
RP 3.3K OHM DIP-14	RES NET	3.3K OHM 14 PIN DIP RESISTER NETWORK	HAMILTON	BOURNS	4114R-002-332

Part Name	Part Type	Description	Distributor	Manufacturer	Part Number
RP 3.3K OHM SIP-10	RES NET	3.3K OHM 10 PIN SIP RESISTOR NETWORK	HAMILTON	BOURNS	4310R-101-332
RP 3.3K OHM SIP-8	RES NET	3.3K OHM 8 PIN SIP RESISTOR NETWORK	HAMILTON	BOURNS	4308R-101-332
			HAMILTON	MEPCO	9S08E13A3321GL002
RV 100K BOURNS 3006	POT	100K 3006 10 TURN PC POT	HAMILTON	BOURNS	3006P-1-104
RV 10K BOURNS 3006	POT	10K 3006 10 TURN PC POT	HAMILTON	BOURNS	3006P-1-103
RV 10K BOURNS 3299	POT	10K 3299 SQUARE-TOP ADJUST POT	HAMILTON	BOURNS	3299W-1-103
RV 10K BOURNS 3329	POT	10K 3329 ROUND-TOP ADJUST POT	HAMILTON	BOURNS	3329P-1-103
RV 20K BOURNS 3006	POT	20K 3006 10 TURN PC POT	HAMILTON	BOURNS	3006P-1-203
RV 50K BOURNS 3006	POT	50K 3006 10 TURN PC POT	HAMILTON	BOURNS	3006P-1-503
RV 5K BOURNS 3006	POT	5K 3006 10 TURN PC POT	HAMILTON	BOURNS	3006P-1-502
RV 5K BOURNS 3329	POT	5K 3329 ROUND-TOP ADJUST POT	HAMILTON	BOURNS	3329P-1-502
RV MFT 7104D-419-103	POT	BOURNS DIP TRIMMER POT - 10K/20K/20K/20K	HAMILTON	BOURNS	MFT 7104D-419-103
SW DIP-2	SWITCH	2 POSITION DIP SWITCH	ANY	ANY	76SB02
SW DIP-4	SWITCH	4 POSITION DIP SWITCH	ANY	ANY	76SB04
SW DIP-6	SWITCH	6 POSITION DIP SWITCH	ANY	ANY	76SB06
SW DIP-8	SWITCH	8 POSITION DIP SWITCH	ANY	ANY	76SB08
SW PB SPDT	SWITCH	SPDT PUSH-BUTTON SWITCH	RICHEY	DIALIGHT	583-1112-010
TEST-POINT EDGE-BLU	HARDWARE	BOARD EDGE TEST POINT (BLUE)	HAMILTON	JOHNSON	105-0760-001
TEST-POINT EDGE-GRN	HARDWARE	BOARD EDGE TEST POINT (GREEN)	HAMILTON	JOHNSON	105-0754-001
TEST-POINT EDGE-RED	HARDWARE	BOARD EDGE TEST POINT (RED)	HAMILTON	JOHNSON	105-0752-001
TEST-POINT EDGE-WHT	HARDWARE	BOARD EDGE TEST POINT (WHITE)	HAMILTON	JOHNSON	105-0751-001
TEST-POINT EDGE-YEL	HARDWARE	BOARD EDGE TEST POINT (YELLOW)	HAMILTON	JOHNSON	105-0757-001
TEST-POINT STUD	HARDWARE	BOARD STUD TEST POINT	HAMILTON	JOHNSON	28-1545-101
TMM2016	IC	2KX8 STATIC RAM	JACO	TOSHIBA	TMM2016P
TMS9914A	IC	IEEE-488 CONTROLLER	RPS ELECTR	T. I.	TMS9914A
uPD7220	IC	GRAPHIC DISPLAY CONTROLLER	ANTHEM	NEC	uPD7220